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A New Twenty-four-inch Engine Lathe.

On this page we give illustrations of a new lathe which possesses some features that are new in lathe construction and performs some functions not before attempted, so far as we are aware.

The perspective engraving gives a good general idea of its appearance and proportions, while Figs. 2, 3 and 4 are devoted to making plain the construction of that which is essentially new in the lathe.

The object of the mechanism seen here is to provide a means of cutting any thread within the capacity of the lathe without changing gears; to provide a wide range for feeding and screw cutting, any rate being at once available, at the pleasure of the operator; and, finally, to automatically reverse the motion of the lead screw and carriage at each end of a screw being cut, the lathe running continuously in the same direction.

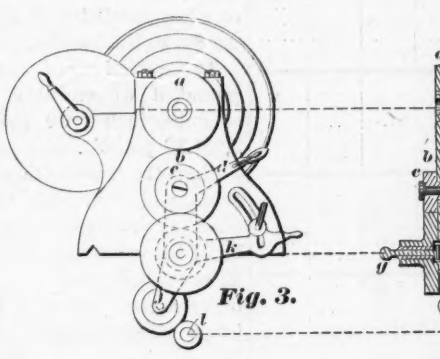


Fig. 3.

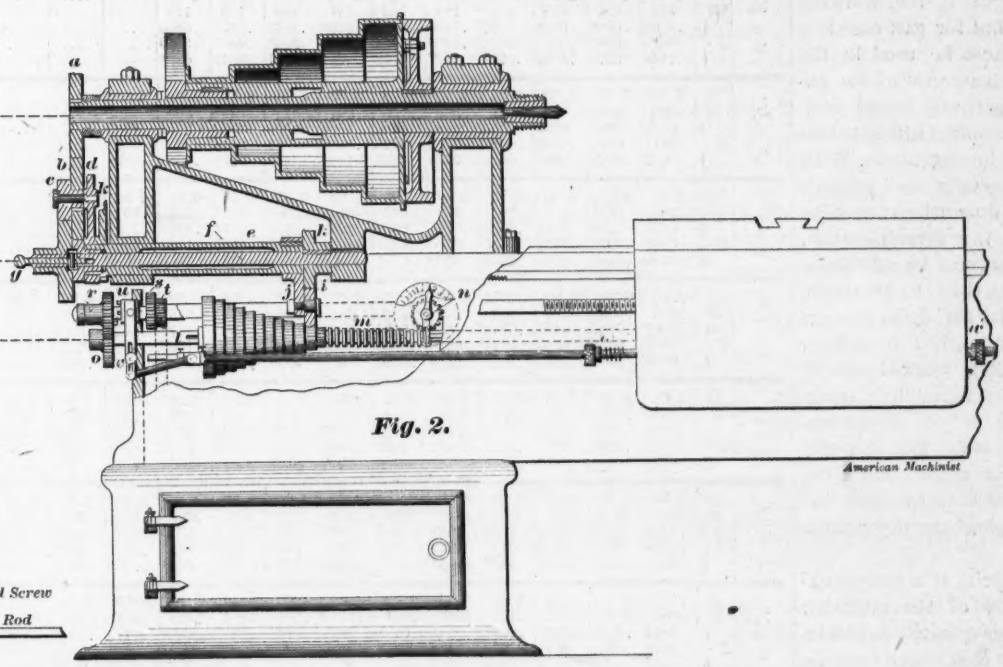


Fig. 2.

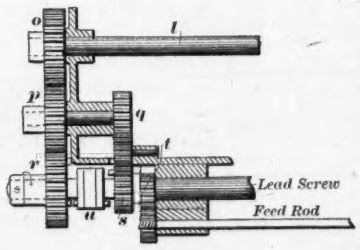
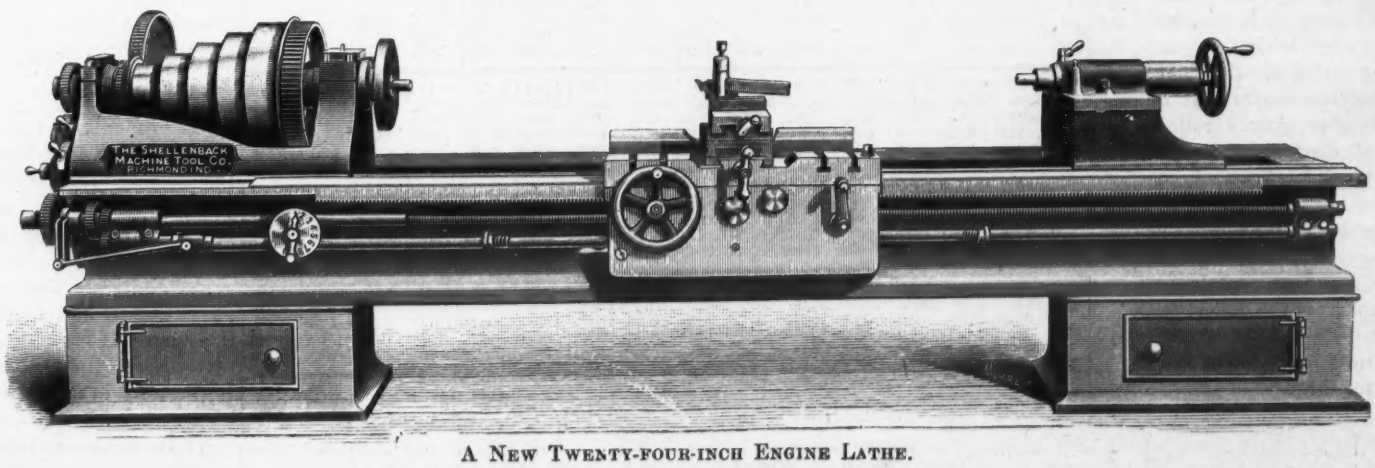


Fig. 4.



A NEW TWENTY-FOUR-INCH ENGINE LATHE.

At the end of the lathe spindle is keyed the gear wheel *a* which engages with a wheel *b* of equal size. The gear *b* is keyed to the hub of the pinion *c*, both these running loose on the stud shown, which is screwed into the quadrant *d*. This quadrant is pivoted below upon an extension of sleeve *e* and turns freely upon it, so that by this means the gears *a* and *b* can be thrown out of contact when desired. Pinion *c* and gear *b* engage with corresponding gears below, which run loosely on shaft *f*, to which either of them may be connected by the sliding key which is attached to the push-pin *g*, and, as pinion *c* has half as many teeth as gear *b*, the gears with which they engage being inversely proportional, it is seen that the shaft is driven at two different rates, according to the position of the key, one rate being four times the other.

At the right-hand end of shaft *f* is keyed the gear wheel *h*, and engaging with this gear is the idler pinion *i*, which turns freely upon a stud screwed into the quadrant or arm *j*, which arm is keyed to the sleeve *e*. Keyed to the opposite end of the sleeve *e* is a quadrant *k*, shown in Figs. 2 and 3, this quadrant having a slotted arm and binding nut, as shown by Fig. 3, for holding it in any desired position. By this means pinion *i*, while it is always in engagement with gear *h*, by which it is driven, may be made to engage with any one of a series of gear wheels seen below it in Fig. 2, these gears being the real "change gears" of the lathe.

In order to effect this engagement of pinion *i* with any one of the change gears, they must be moved endwise to the proper position for the desired gear, and for this purpose they are all keyed to a sleeve which is splined to shaft *l*. The continuation of the sleeve to which the change gears are keyed is formed into a cylindrical rack *m*, which is moved endwise, carrying the change gears with it by means of a pinion which is on the same shaft as that to which the index handle *n* is secured, the point of which, passing over the graduations on the fixed circular plate behind it, indicates by the numbers the thread which the lathe will cut with the pointer in that position—the corresponding change gear being brought under the idler pinion *i* by the movement of the index hand and pinion; *i* being then engaged with the change gear by moving the arm *j* by means of the quadrant *k*, and clamping it in position. It will of course be understood that each change gear will then give two pitches of screws, one four times the lead of the other, by means of the shifting key and push pin *g*.

At Fig. 4 we show the method of transmitting motion from the shaft *l* to the lead screw and feed rod. At the outer end of the shaft *l* is secured a gear *o*, which engages with the gear *p* keyed to a short shaft, at the other end of which shaft is keyed the gear *q*. The gear *p* drives gear *r* directly, while gear *q* drives gear *s* through the medium of an idler, as shown, so that gears *r* and *s* revolve in opposite directions, *s* revolving the faster, owing to the relative proportions of the gears. Gears *r* and *s* run loosely on the lead screw, and are provided on their inner faces with pins which are adapted to engage with corresponding pins on a clutch which is splined to the lead screw between them, so that by moving this clutch the screw is either stopped or reversed; running in one direction about twice as fast as in the other. On the hub of gear *s* is fastened the gear *t*, which engages with and drives a gear on the end of the feed rod as shown. Thus by putting the clutch *u* in its mid position, motion is transmitted through the gears to the feed rod without turning the screw, and for the feed rod all the varieties of speed can be obtained that are given by the gearing as explained.

The clutch *u* is thrown by means of a lever *v* (Fig. 2) having upon its front face a T slot to which is connected a rod that is connected at the other end to a collar on the feed rod, as shown. The feed rod is adapted to slide endwise a short distance, in order to throw this clutch, the gear which is on the end of the rod being splined, to allow this movement. It is moved automatically by means of the knurled collars *w w'* which may be fastened to the rod at any desired points. Each collar is provided with a spiral spring, the stiffness of which is not sufficient to throw the clutch when the latter is engaged and driving the screw, the disengagement being effected positively by the movement of the carriage; but before this disengagement takes place the spring is compressed, and, upon the clutch being disengaged, and thereby made to move with less resistance, the spring extends and quickly throws it into engagement with the opposite gear, reversing the screw and the carriage. When cutting left-hand screws the rod can be connected to the lever *v* above the center upon which the lever turns, and thus the backing motion of the carriage is made the faster, whether right or left hand screws are being cut.

It should be said in favor of the lathe that while it seems somewhat complicated, and to make use of a comparatively large number of gear wheels, the mechanism is in reality simple, and that most of the gears, while they are in place ready for use when wanted, are not really in use nor subjected to any wear whatever until needed. Only one change gear, for instance, is actually in use at any one time, and in cutting a given thread there are only four more gears in use on this lathe than on the simple geared lathe of ordinary construction, except in backing the carriage, when there are six more, while the result accomplished by their use is to make the lathe very complete for screw cutting, any indicated pitch being instantly available, and the automatic reversing of the carriage adding very much to its convenience, especially in duplicate work, and tending toward the avoidance of accidents, and economy of time. The lathe cuts threads as follows:

With the pin in, 1, 1¼, 1½, 1¾, 2, 2¼, 2½, 2¾, 2⅞, 3, 3½ per inch.

With the pin out, 4, 5, 6, 7, 8, 9, 10, 11, 11½, 12, 14 per inch.

There are 22 rates of feed by the rod, ranging from 4 to 64 to the inch.

The head-stock in the 24′ lathe is 33′ long. The spindle is of hammered crucible steel with front bearing 3⅛″ diameter, 6¼″ long, rear bearing 2⅞″x4½″. The spindle

has a 2¼″ hole through it and runs in phosphor bronze bearings. The cone has five steps for a 3½″ belt, the smallest step being 6″ and the largest 16″ diameter. It has a bearing on the spindle 14″ long. The ratio of the back gears is 16 to 1. All driving pinions are cut from solid steel blanks.

The carriage is 31′ long rests on large Vs, and is gibbed front and back. It can be locked to the bed when facing, and the rack pinion can be disengaged when cutting screws. It has automatic cross-feed, compound rest, and, when desired, a taper attachment.

The foot-stock has a bearing on the bed 18″ long, and the spindle is of steel 2¼″ diameter, 18″ long, having a traverse of 14′.

The bed is 24″ wide, 14″ deep, thoroughly braced inside, and supported on cabinet legs which form convenient receptacles for tools and fixtures. The lathe is made in three sizes, 18, 21 and 24″, with any desired length of bed, by the Shellenback Machine Tool Co., Richmond, Ind.

Spiral Springs.

BY J. BEGTRUP.

The dimensions of almost any part of a machine or structure may be calculated so as to give sufficient strength, if the working conditions are known; but for cast metals a high factor of safety must be used in the formulas for strength, on account of the uncertainty of getting a perfectly sound casting or a casting of the assumed ultimate tensile strength or perfectly homogeneous. With wrought metal, and especially steel of moderate proportions, the dimensions may be carried much closer to the theoretic limit. The amount of deflection can be calculated with far greater accuracy than the resistance to breaking, and formulas for deflection are of particular value when applied to springs. Such formulas have been worked out by mathematicians probably more than thirty years ago, but they are as yet almost unknown to the practical world. The modulus of elasticity for steel varies but very little, and it is therefore possible to calculate the deflection of steel springs of any description with great accuracy.

The modulus of elasticity is a correct expression for the elasticity of the material, and it is well to have this quantity separately denoted by the letter E in every formula for deflection, for then the same formula may be used for all brands of steel when the modulus of elasticity is known, or it may be possible for practical experimenters to decide whether any other factor should enter the formula to give correct results It is possible that the surface or skin of rolled steel has a modulus of elasticity different from the inside. Such condition has not been taken into account in the mathematical formulas, but would probably be necessary in order to give absolutely correct results. I have in the AMERICAN MACHINIST of January 7, 1888, given formulas for the deflection and carrying capacity of spiral springs of round and square steel, and repeat them here with a little alteration for the sake of convenience.

$$W = .3927\,\frac{S\,d^3}{D-d} \qquad F = 8\,\frac{P(D-d)^3}{E\,d^4}$$ for round steel.

$$W = .471\,\frac{S\,d^3}{D-d} \qquad F = 4.712\,\frac{P\,(D-d)^3}{E\,d^4}$$ for square steel.

W = carrying capacity in pounds.
S = greatest tensile stress per square inch of material.
d = diameter of steel.
D = outside diameter of coil.
F = deflection of one coil.
E = torsional modulus of elasticity.
D = load in pounds

From these formulas the following table has been calculated. It will be found of value in designing automatic engines, car springs, safety valves, weighing machines, etc.

A spring being made of an elastic material, and of such shape as to allow a great amount of deflection, will not be affected by sudden shocks or blows to the same extent as a rigid body, and a factor of safety very much less than for rigid constructions may be used.

HOW TO USE THE TABLE.

When designing a spring for continuous work as a car spring, use a greater factor of safety than in the table; for intermittent working, as in a steam engine governor or safety valve, use figures given in table; for square steel multiply line W by 1.2 and line F by .59.

TABLE GIVING CARRYING CAPACITY AND DEFLECTION OF SPIRAL SPRINGS OF ROUND STEEL. d = DIAMETER OF STEEL. D = OUTSIDE DIAMETER OF COIL. W = SAFE WORKING LOAD IN POUNDS—TENSILE STRESS NOT EXCEEDING 60,000 POUNDS PER SQUARE INCH. F = DEFLECTION BY A LOAD OF 100 POUNDS OF ONE COIL, AND A MODULUS OF ELASTICITY OF 10, 12 AND 14 MILLIONS RESPECTIVELY. THE ULTIMATE CARRYING CAPACITY WILL BE ABOUT TWICE THE SAFE LOAD.

d = .065″ No. 16.	D	.25	.50	.75	1.00	1.25	1.50	1.75	2.00							
	W	35	15	9	7	5	4 5	3.8	3.3							
	F	.0276	.3588	1.433	3.562	7.250	12.88	20 85	31.57							
		.0236	.3075	1.228	3.053	6 214	11.04	17.87	27.06							
		.0197	.2562	1.023	2.544	5.178	9.200	14.89	22.55							
d = .120″ No. 11	D	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2 50						
	W	107	65	46	36	29	25	22	19	17						
	F	.0206	.0937	.2556	.5412	.9856	1.624	2 492	3 625	5 056						
		.0176	.0804	.2191	.4639	.8448	1.392	2.136	3.107	4.334						
		.0147	.0670	.182.	.3866	.7040	1.160	1.780	2.589	3 612						
d = .180″ No. 7.	D	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2 75	3.00					
	W	241	167	128	104	88	75	66	59	53	49					
	F	0137	.0408	.0907	.1703	.2866	4466	.6571	.9249	1.256	1.660					
		.0118	.0350	.0778	.1460	.2457	.3828	5632	.7928	1.077	1.423					
		.0098	.0292	.0648	.1217	.2048	.3190	.4693	.6607	.8975	1.186					
d = ¼″	D	1.25	1 50	1.75	2.00	2.25	2 50	2 75	3.00	3 25	3.50					
	W	368	294	245	210	184	164	147	134	123	113					
	F	.0199	.0389	.0672	.1067	.1503	.2270	.3109	.4139	.5375	.6835					
		.0171	.0333	.0576	.0914	.1365	.1944	.2665	.3548	.4607	.5859					
		.0142	.0278	.0480	.0762	.1137	.1610	.2221	.2957	.3839	.4883					
d = 5/16″	D	1 50	1.75	2.00	2.25	2.50	2.75	3 00	3.25	3.50	3.75	4.00				
	W	605	500	426	371	329	295	267	245	226	209	195				
	F	.0136	.0242	.0392	.0593	.0854	.1187	.1583	.2066	.2640	.3312	.4089				
		.0117	.0207	.0336	.0508	.0732	.1012	.1357	.1771	.2263	.2839	.3505				
		.0037	.0173	.0280	.0424	.0610	.0853	.1131	.1476	.1886	.2366	.2921				
d = ⅜″	D	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50				
	W	765	663	589	523	473	433	398	368	343	321	301				
	F	0169	.0259	.0377	.0528	.0711	.0935	.1200	.1513	.1874	.2290	.2761				
		.0145	.0222	.0323	.0452	.0610	.0801	.1029	.1297	.1606	.1963	.2367				
		.0120	.0185	.0269	.0376	.0508	.0668	.0858	1081	1338	.1635	.1972				
d = 7/16″	D	2 00	2.25	2.50	2 75	3.00	3.25	3 50	3.75	4 00	4.25	4.50	4.75	5.00		
	W	1263	1089	957	853	770	702	644	596	544	518	486	456	432		
	F	.0081	.0126	.0186	.0262	.0357	.0472	.0617	.077	.0960	.1176	1423	.1702	.2016		
		.0069	.0108	.0160	.0225	.0303	.0405	0529	.066	.0823	.1008	.1220	.1459	.1728		
		.0058	.0090	.0133	.0187	.0255	.0337	.0441	.0551	.0686	.0840	.1017	.1216	.1440		
d = ½″	D	2.00	2.25	2 50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4 50	4.75	5.00	5 25	5 50
	W	1963	1683	1472	1309	1178	1071	982	906	841	785	736	693	654	602	589
	F	.0042	.0067	.0099	.0141	.0194	.0259	.0336	.0427	.0534	.0656	.0796	.0955	.1134	.1333	.1555
		.0036	.0057	.0085	.0121	.0167	.0222	.0288	.0366	.0457	.0562	.0683	.0818	.0972	.1148	.1333
		.0030	.0048	.0071	.0101	.0139	.0185	.0240	.0305	.0381	.0469	.0569	.0682	.0810	.0953	.1111
d = 9/16″	D	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00
	W	2163	1916	1720	1560	1427	1315	1220	1137	1065	1001	945	894	849	808	771
	F	.0056	.0081	.0112	.0151	.0197	0252	.0316	.0390	.0474	.0571	.0679	.0800	.0935	.1085	.1248
		.0048	.0070	.0096	.0129	.0169	.0216	0271	0334	.0406	.0489	.0582	.0686	.0801	.0930	.1071
		.0040	.0058	.0080	.0108	.0141	.0180	.0225	.0278	.0339	0408	.0485	.0572	.0668	.0775	.0892
d = ⅝″	D	2 50	2 75	3 00	3.25	3 50	3.75	4.00	4.25	4.50	4 75	5.00	5.25	5.50	5.75	6.00
	W	3068	2707	2422	2191	2001	1841	1704	1587	1484	1394	1315	1244	1180	1122	1070
	F	.0034	.0049	.0068	.0092	.0121	.0155	.0196	.0243	.0297	.0358	.0427	.0504	.0591	.0686	.0791
		.0029	.0042	.0058	.0079	.0104	.0133	.0168	.0208	.0254	.0307	.0366	.0432	.0506	.0588	.0679
		.0024	.0035	.0049	.0066	.0086	.0111	.0140	.0173	.0213	.0255	.0305	.0360	.0422	.0490	.0565
d = 11/16″	D	3 00	3.25	3.50	3.75	4 00	4 25	4.50	4.75	5.00	5.25	5.50	5 75	6 00		
	W	3311	2988	2723	2500	2311	2151	2009	1885	1776	1678	1591	1513	1441		
	F	.0043	.0058	.0077	.0100	.0127	.0157	.0193	.0233	.0279	.0330	.0388	.0452	.0522		
		.0037	.0050	.0066	.0086	.0108	.0135	.0165	.0200	.0239	.0283	.0333	.0387	0447		
		.0030	.0042	.0055	.0071	.0090	0112	.0138	.0167	.0199	.0236	.0277	.0323	.0373		
d = ¾″	D	3 00	3.25	3.50	3.75	4 00	4.25	4.50	4.75	5 00	5.25	5.50	5.75	6.00		
	W	4418	3 76	3615	3318	3058	2840	2651	2485	2339	2209	2093	1988	1893		
	F	.0028	.0038	.0051	.0066	.0084	.0105	0129	0157	.0189	.0224	.0264	.0307	.0356		
		.0024	.0033	.0044	.0057	.0072	.0090	.0111	.0135	.0162	.0192	.0226	.0263	.0305		
		.0020	.0027	.0036	.0047	.0060	.0075	.0093	.0113	.0135	.0160	.0188	.0220	.0254		
d = 13/16″	D	3 50	3 75	4 00	4.25	4 50	4.75	5.00	5.25	5.50	5.75	6 00	6.25	6.50		
	W	6013	5490	5051	4676	4354	4073	3826	3607	3413	3237	3080	2936	2806		
	F	.0021	.0027	.0035	.0045	.0055	.0067	.0081	0097	.0115	.0134	.0156	.0180	.0207		
		.0018	.0024	.0030	.0038	.0047	.0058	.0070	.0083	.0098	.0115	.0134	.0155	.0177		
		0015	.0020	.0025	.0032	.0039	.0048	.0058	.0069	.0082	.0096	.0112	.0129	.0148		
d = 1″	D	3.50	3.75	4 00	4 25	4.50	4 75	5.00	5.25	5.50	5.75	6 00	6.25	6.50	6 75	7 00
	W	9425	8568	7854	7250	6732	6288	5890	5544	5236	4960	4712	4488	4284	4098	3927
	F	.0012	.0016	.0021	.0026	.0033	.0041	.0049	.0059	.0071	.0083	.0097	.0112	.0129	.0148	.0168
		0010	.0014	.0018	.0023	.0028	.0035	.0043	.0051	.0061	.0071	.0083	.0096	.0111	.0127	0144
		.0008	.0011	0015	.0019	.0023	.0029	.0035	.0043	.0051	.0059	.0069	.0080	.0092	.0106	.0120

CALCULATED BY J. BEGTRUP.
FEBRUARY, 1890.

Example 1.—How much will a spring of ⅜″ round steel and 3′ outside diameter carry with safety? In the line headed D we find 3, and right underneath 473, which is the weight it will carry with safety. How many coils must this spring have so as to deflect 3″ with a load of 400 pounds? Assuming a modulus of elasticity of 12 millions we find in the center line headed F the figure .0610; this is deflection of one coil for a load of 100 pounds; therefore .061 × 4 = .244″ is deflection of one coil for 400 pounds load, and 3 ÷ .244 = 12½ is the number of coils wanted. This spring will therefore be 4½″ long when closed, counting working coils only, and stretch to 7½″.

Example 2.—A spring 3½″ outside diameter of 7/16″ steel is wound close; how much can it be extended without exceeding the limit of safety? We find maximum safe load for this spring to be 702 pounds, and deflection of one coil for 100 pounds load .0405 inches; therefore 7.02 × .0405 = .284′ is the greatest admissible opening between coils. We may thus, without knowing the load, ascertain whether a spring is overloaded or not. There are numerous other ways in which the table will be found useful as a ready means of comparing the efficiency of springs of different dimensions and selecting the one best suited to the purpose; but these will readily suggest themselves after a little practice. It is to be hoped that this table will be tested, corrected and extended by those having occasion to use it.

A Study of Fly-wheels

BY LEICESTER ALLEN.

To find the living force stored in any moving mass of matter, it can be shown that it is sufficiently accurate to divide the velocity in feet per second by eight, square the quotient, and multiply the square so found by the weight of the mass in pounds. The final product will be the number of foot-pounds of work which the moving mass can perform before coming to rest.

This rule is based upon the assumption that a constant force equal to that of gravity will impart to a pound of matter a velocity of thirty-two feet in a second of time. In reality such a force will impart a small fraction more than thirty-two feet velocity; hence the rule is not strictly exact, but, as already stated, it is sufficiently so for most practical purposes.

Let us now suppose a cast-iron fly-wheel of twelve feet diameter, having a rim of rectangular cross-section whose dimensions are four inches measured on the radius of the wheel and six inches measured on a line parallel with the axle, and which is making 150 turns per minute.

In order to determine the force that will be stored in the rim at this speed we have first to find the weight of the rim, and second, the mean velocity of the mass, before the simple rule above given can be applied.

The weight of the rim will be the difference between the weights of two disks, one twelve feet in diameter and six inches thick, and another of the same thickness eleven feet four inches in diameter; or expressing these dimensions in inches, one of 144 inches diameter and six inches thick, and one of 136 inches diameter and of the same thickness.

Most engineers and draftsmen have at hand a table of areas corresponding to different diameters of circles, but in the absence of such a table the common arithmetical method of obtaining areas when diameters are given may be used.

We find for the disk of 144 inches diameter an area of 16,286.05 square inches, and for a disk 136 inches in diameter, an area of 14,526.76. The difference of these areas is 1,759.29 inches. Multiplying this area by 6 inches, the thickness of the rim as measured on a line parallel with the axis of the wheel, we get 10,555.74 cubic inches.

As a cubic inch of cast-iron weighs 0.2607 pound, if we multiply this by the number of cubic inches we find the weight to be 2,751.88 pounds.

Since the cross-section of the rim is a rectangle, and it is plain that all points in the outer circumference will have a greater velocity than points on the inner circumference, it is evident that the mean velocity will be on a circle between the interior and exterior circumferences. The mean between the interior and exterior diameters of the rim will be, for practical purposes, a sufficiently near approximation to the diameter of a circle in which a point of the mass will have the mean velocity required. We find this diameter to be 140 inches, and the circumference corresponding to it is 439.824 inches or 36.652 feet.

We now have the weight of the rim 2,751.88 pounds, and the mean velocity 36.65 feet. Applying the rule given, we find the living force expressed as follows:

$$\left(\frac{36.65}{8}\right)^2 \times 2{,}751.88 = \text{work in foot-pounds; or}$$

$$\frac{(36.65)^2}{8^2} \times 2{,}751.88 = \text{work in foot-pounds.}$$

Performing the indicated operations we find the work that the rim can perform before coming to rest is 57,759 foot-pounds.

The square of 8 is always a divisor in this operation, and hence the rule may be given as follows:

Rule.—Divide the weight of the rim in pounds by 64 and multiply the quotient by the square of the velocity of the mass expressed in feet per second. The result will be the work in foot-pounds stored in the rim of the wheel.

As the spokes and hub of a fly-wheel are of little weight as compared with the rim, and their mean velocity is much smaller, it is usual to leave them out of the calculation. The result is that the stored-up force in a fly-wheel as above computed is always somewhat less than the actual full work.

Now the conditions of movement possible to the motion of fly-wheels are as follows:

1. The impelling force that imparts motion, and the resistance to the motion may each be constant. If both be equal and constant, the wheel, if at rest, will not turn.

If the constant impelling force and the constant resistance be equal, and the wheel be already in motion, the velocity of its motion will remain unchanged so long as the conditions remain unchanged.

If the constant impelling force be greater than the constant resistance, the velocity of the motion will be uniformly increased.

If the constant resistance be greater than the constant impelling force, the velocity will

diminish uniformly and the revolution of the wheel will finally cease.

2. The impelling force may be variable while the resistance is constant. In this case, the velocity of the wheel will vary between a maximum and a minimum.

3. The impelling force may be constant while the resistance is variable. In this case, also, the velocity will vary between a maximum and a minimum.

4. Both the impelling force and the resistance may be variable. In this case, the velocity may vary between a maximum and a minimum, or if the impelling force and the resistance increase and decrease alike and synchronously, the velocity may be constant.

The term resistance is intended to mean the sum of all resistances, inclusive of friction, on the journals of the fly wheel itself.

Under the first-named conditions a fly-wheel would be worse than useless, because the purpose of a fly wheel is to secure immunity from undue fluctuations of velocity, and as when the impelling force and the resistance are equal and constant, bodies in motion will not change their velocity, a fly-wheel adds by the friction of its journals to the resistance, and necessitates an increased expenditure of power to maintain the existing motion.

An example of the first set of conditions would be a turbine working under a constant head and constant gate opening and raising a weight through the action of intervening hoisting mechanism.

An example of the second set of conditions is a steam engine cutting off at some point of its stroke and employed for hoisting a weight. An example of the third set of conditions would be a turbine working as above described and operating a tilt hammer.

An example of the fourth set of conditions is a cut-off steam engine driving a tilt hammer, a train of rolls, a shearing machine or a punching press.

In nearly every industrial operation where motive power is required, a variation of velocity in the motor beyond a certain limit is detrimental. It is therefore needful in designing a fly-wheel for regulating motion, to consider first what amount or percentage of variation in velocity is permissible; or, to put it in another form, to decide what is the least allowable variation of velocity.

The decision must depend upon the nature of the service to which the motor is to be applied. A variation that would do no harm in the driving of an air compressor would utterly unfit an engine for driving dynamos in an electric lighting station. No rule can be given to aid a decision as to the amount of variation that can be allowed. Experience, as recorded in books or gained in practice, must be the guide; but when the variation has been once decided upon, a fly-wheel may be designed that will give the desired results.

Let us suppose, for instance, that we are to drive a shearing machine for cutting iron bars by a turbine, and that the shears are geared back to the shaft in such manner that the cut is made during a single turn of the fly-wheel, and that the velocity lost during the cutting is to be regained during three succeeding turns. Let us suppose further that the work required for each actual cutting has been found by calculation, inclusive of friction under load, to be 12,500 foot-pounds, and that our fly-wheel is to make sixty turns per minute. Let it also be required that the variation of mean velocity of the fly wheel shall not exceed eight per cent.

It is evident at once that, as the entire power for each cutting is supplied by the turbine during four turns of the fly wheel, while the cutting is done during a single turn, the living force stored up during the intervals of cutting and to be given out by the rim during a single turn, must be equal to the performance of three-fourths of the work, or 9,375 foot-pounds.

It is now required to find a weight of rim such that when in motion, making sixty turns per minute, its loss of velocity during a single turn shall, by the performance of 9,375 foot-pounds of work, be reduced only eight per cent. of the mean velocity.

If we return to the rule for finding the work stored in a rim of ascertained weight moving at a specified velocity, we can see that by the use of arithmetical symbols it can be written as follows:

$$\frac{\text{Weight of rim in pounds}}{64} \times \text{square of velocity} = \text{work in foot-pounds.}$$

And multiplying each of the expressions separated by the sign of equality by 64, we also have weight of rim in pounds × square of velocity = 64 times the work in foot-pounds; and if now we divide each expression separated by the sign of equality by weight of the rim in pounds, we get another useful equation:

$$\frac{\text{64 times the work in foot-pounds}}{\text{weight of rim}} = \text{square of velocity.}$$

Inspection of the last equation shows that when the work in foot-pounds is not variable, the weight of the rim can be diminished in exact proportion as the square of its velocity is increased, and hence, as the number of turns is definitely fixed, the only way to make our wheel effective, and at the same time to save metal in its construction, is to make its diameter as large as practical limitations will admit. We will suppose that the limit of diameter is fixed upon as sixteen feet measured from the line of mean velocity in the rim.

We have, therefore, an average velocity on this line of 50.2656 feet per second. A variation in velocity of eight per cent. means that, when the reduction of velocity through the performance of work begins, the velocity shall be four per cent. higher than the average, and that at the instant when the so reduced velocity begins to gain acceleration the velocity shall be four per cent. below the average—that is to say, the maximum velocity will be 52.276 feet per second, while the minimum velocity will be 48.155 per second.

Now it is a physical law that any acceleration or retardation of velocity is due to work expended in producing acceleration, or performed in producing the retardation. No acceleration of the velocity of a moving mass can be accomplished without expenditure of work upon the mass, and no retardation can take place without the performance of work by the moving mass upon some other body. Another physical law is that the work so expended or performed in the acceleration or retardation of moving masses is directly as their weights—that is to say, if it requires a certain amount of work to increase or diminish the velocity of one pound of matter any number of feet per second, to equally increase or retard the velocity of two, three or four pounds of matter, will require two, three or four times the work expended upon or performed by the single pound, and so on.

Another physical law is, that to increase or diminish the velocity of a moving mass any given amount requires an amount of work equal to the difference of the work the body has stored in it at the initial velocity, and at the final velocity respectively.

Our problem then is to find what weight the rim must have in order that the expenditure of 9,375 foot pounds of work upon it would reduce its velocity the difference between the maximum and minimum velocity as above computed, which we find to be 52.276 — 48.155 feet per second, or 4.121 feet per second.

Taking the formula above given, weight of rim in pounds × square of velocity = 64 times the work in foot-pounds, the following derived rule may be written as follows:

To find the weight in pounds of a fly-wheel rim that will, at a given velocity per second measured on the line of mean velocity, be retarded in velocity a specified amount by the performance of a stated quantity of work expressed in foot-pounds.

Rule.—Divide 64 times the work in foot-pounds by the difference of the squares of the maximum and minimum velocities expressed in feet per second.

Applying this rule to the fly-wheel of our shearing machine, we have, as an expression of the weight of the rim, the following:

$$\frac{64 \times 9{,}375}{(52.276)^2 - (48.155)^2} = 1{,}449.6 \text{ pounds.}$$

Other interesting problems connected with fly-wheels remain to be considered.

Sperry's Micrometer Scale.

This micrometer scale has been devised by a draftsman and engineer for his own practical use in measuring with dividers for drawing, planning, designing, calculating, and the performing of graphical operations, he wanting something better than graduated scales, and there being nothing else in the market for this special purpose. After considerable use, this scale has become almost indispensable, saving much time in producing better work, and being so simple and convenient, it is a pleasure to use the instrument and have the satisfaction of obtaining accurate results. It is an ideal proportional scale, measuring to the one-thousandth part by direct reading.

This scale is specially designed for the convenient application of the points of dividers in measuring, and to facilitate the setting of the pen and pencil of dividers for drawing. It will be useful for draftsmen, engineers, machinists, surveyors and architects, for measuring, obtaining proportions, and laying off the various dimensions of drawings, and all purposes where accurate measurements are made, dimensions taken or values obtained with dividers and a scale.

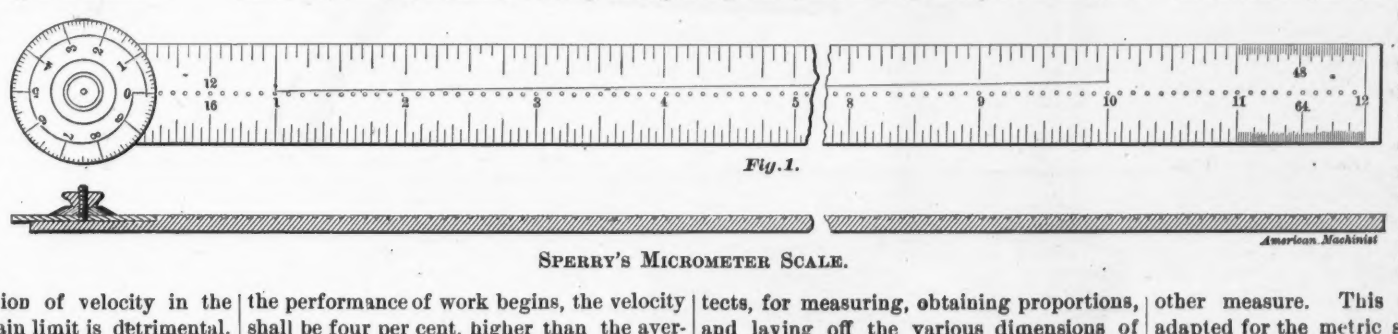


Fig. 1.

SPERRY'S MICROMETER SCALE.

The accuracy of such work and the advantage of employing such methods depend directly upon the accuracy and facility with which the measurements are made. For this purpose, effective means are required for applying the points of dividers for making these measurements correctly, more readily and to smaller fractions than can be done with a graduated rule. This can be accomplished with the micrometer scale in a very quick and easy manner for practical work.

The principal feature of this invention is the row of conical indentations or dots on the face of the scale, in combination with the disk at the end having a spiral line and suitable graduations upon its face. On this scale the dots are one-tenth of an inch apart. When the disk is in its normal position, the spiral line at the point nearest to the row of dots is one-tenth of an inch from the first dot, and this distance increases regularly one tenth inch in proportion as the disk is turned one revolution. The circumference of the disk is graduated into one hundred equal divisions, and every tenth division is numbered to indicate hundredths of an inch, the intermediate subdivisions indicating thousandths of an inch. Then, simply, the distance between any of the dots and the spiral line will be varied one-hundredth of one-tenth inch or one-thousandth of an inch for every division the disk may be turned, until another tenth of an inch is measured and another dot may be taken. The dots being so far apart make it quite an easy matter to place a point of the dividers in the one required, and then, the disk having been turned to represent the fractional part required, the other point (or the pen or pencil) can be brought to the spiral line, and this being a single line enables one to measure and use thousandths as readily and quickly as longer distances. The stud upon which the disk turns is at the proper distance to one side of an extended imaginary line through the row of dots, so that the spiral line will cross this center line at right angles and the point of the dividers will describe a circular arc meeting the spiral on this line. The oblique line extending from a point corresponding to the beginning of the scale to a point one-tenth of an inch from the one-hundredth dot, or tenth inch, provides convenient means for measurements by thousandths for distances less than one-tenth inch. The figures which indicate the number of inches on the scale also indicate the number of hundredths from their respective dots to the oblique line; the intermediate dots giving the thousandths of an inch.

To set dividers one inch and one hundred and twenty-five thousandths (1.125 inches), turn the disk to the fifth division beyond the one numbered 2, then place one point of the dividers in the first dot above one inch on the scale and bring the other point to move in an arc meeting the spiral on the disk. To get forty-five hundredths (.45 inch), turn the disk to five hundredths and take four tenths on the scale. For 2.675 inches, take two inches and six tenths on the scale and seven hundredths and five thousandths on the disk. To find a dimension taken with dividers, place one point of them in a dot that will bring the other point within the scope of the spiral line, then turn the disk until the spiral meets the arc described by the point, when the distance can be read directly in inches and tenths on the scale and the hundredths and thousandths on the disk.

As a scale of parts, of course, it makes no difference what the measure is, for the row of dots may represent inches, feet, chains or miles of the English measure, millimeters or any of its multiples of the French measure, German or any other measure. This scale is also well adapted for the metric system, placing the dots one millimeter apart and making the scale one fourth of a meter long.

The principle of this scale is unlimited, for, by increasing the number of divisions on the disk, or by lessening the pitch of the spiral, or by doing both, measurements can be made by infinitely small distances, limited only by our ability to make and use the instrument; and the smallest fractions desired can be read just as easily as larger ones, for in every distance measured there is a dot at one end and a single line at the other, both of which are far enough from all other divisions to be plainly seen.

In many operations it is absolutely necessary to measure exactly and by small fractions, while in some other work fine measuring may not be so important, but if measurements can be made by thousandths as easily as by larger fractions, it is, without question, preferable to do so. The accuracy of mechanical and engineering work is constantly increasing, and devices for all kinds of fine measuring must be used. The micrometer scale is especially intended to assist in producing more accurate work with less difficulty, by providing convenient and effective means for making measurements by small fractional distances quickly and without requiring the eyesight to read very fine and closely graduated division lines.

This scale is the invention of Mr. Chas. Sperry, Port Washington, L. I.

The following is a special to the *Telegram:*

A young man named Edward A. Twist, employed at O Keefe Brothers' meat market, on Reynolds street, last evening, just after the storm came on, while walking on Mt. Hope avenue on his way to his home in Sanford street, came in contact with a broken fire alarm wire, which hung over the walk and was crossed with a trolley. The electric fluid entered his neck and he was instantly killed.

Universal Radial Drill Press.

In our issue of July 7 we illustrated and described a radial drill press made by the Lodge & Davis Machine Tool Co., of Cincinnati, O. Our present illustration is of a machine which possesses many of the same features, but is universal and has an improved back gear arrangement.

Like the former machine, the column is supported upon a stump which is attached to the bed-plate, and which is of enlarged diameter and having the joint brought as near the arm as possible. Between the flange faces are balls which form the bearing when the column is turned, and the thrust of the spindle and elevating screw is also taken on ball bearings. The cone pulley is placed at the bottom of the column, and is provided with back gears which are incased within it, so that they are protected from dirt and accidental injury, the workman being also protected by this arrangement. The gears are thrown in or out by the movement of the vertical lever seen near the pulley.

Through the center of the column passes the main driving shaft, from which the short horizontal shaft is driven which passes out through a slot in the front of the column, this short shaft driving the shaft which passes through the arm.

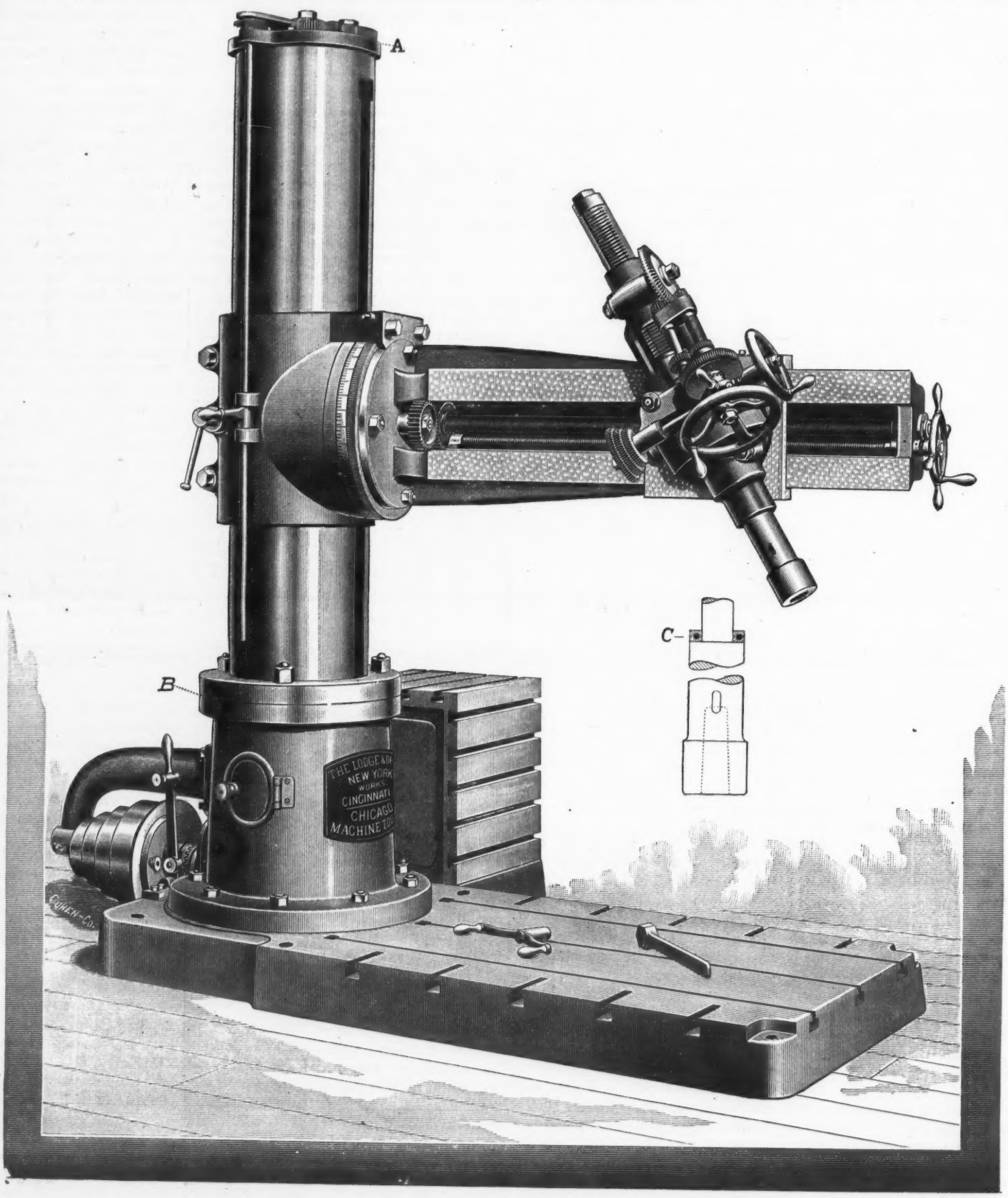
The arm swivels on the sleeve, and the head upon the saddle, both being graduated.

The upper and lower screws at the back of the sleeve are readily adjusted to keep the sleeve an easy working bearing on the column, while the clamping is done by the central screw which is provided with a vise handle for that purpose.

The circular face for swiveling the arm is relatively large, bored in the center to receive the pivot of the arm, and the worm-wheel for revolving the arm is made of phosphor bronze. The shoe on top, bearing the worm for revolving the arm, is bolted solidly against the sleeve, overlaps the flange on the arm, and is scraped to a working fit, which arrangement avoids deflection in the central shaft and binding in the pivot, when the bolts are loosened for revolving the arm The arm is of the box girder shape—not intersected at the back for gearing—and has a wide face for the drill head. The drill head makes an entire revolution on the saddle, and is graduated. The arm is raised and lowered by power. The drill spindle is extra large in diameter, has an extra long traverse movement, and is balanced by a novel spring balancing device.

The feed is obtained by a rack and pinion, and can be released instantaneously by a special new quick-return device operated by the large hand-wheel shown on the cut. This is almost an indispensable feature for tapping. Three different changes of feeds are obtained by gearing, and can be changed from one to the other while the drill is running.

A double friction countershaft for tapping is furnished with each drill.



UNIVERSAL RADIAL DRILL PRESS.

Some Remarks.

BY W. D. FORBES.

Machine shop practice seems to dictate that certain tools should be but rarely assigned to a workman as is a lathe or a planer.

Noticeably is this the case with the drill press, and from this system it has become not only one of the most abused, but also one of the most expensive to maintain.

Before going further into the question of this tool, it is worth while to notice that it is an exception in machine tools in its design, that is, to a certain extent; most mechanics in laying out a bearing provide some means for taking up wear, but in the spindle of a drill press the writer has never seen any such provision or need of any; what is curiously called a "solid hole" in a vertical position seems to give no trouble as to wear.

Not long ago the writer bought a small drill press; it was in general appearance graceful and strong; it was very convenient to handle, and the workmanship was perfect—no better could be found in any machine tool known to the writer; the maker failed to put his name on it, as he should have done, as such a piece of work was a credit to him; this tool cost only $75—at such a price one could afford to throw away a press once a year, and the usual method of having it anybody's tool would make it almost necessary if good work was desired.

It is not human to oil up for a few minutes' job; it is as much as can be expected of a man to do so when he has a long piece of work and a few short jobs; and no oil gives the shop doctor a chance to show himself, and relegates the press to the second-rate list.

In general, the work done on a drill press is not fine, nor does it require great skill, but it requires some, and at times considerable; to get a hole just where it is wanted and to size is not an easy job, and can hardly be expected from a man who works for laborer's wages, which is the grade usually to be found in charge of this tool, if any.

It is fair to presume that it pays to put a good man on a tool, and provide him with enough work to keep him going, and hold him responsible for the condition of same and the quality of the work; it costs considerably less to drill a hole in its proper position even at a greater outlay for labor than to file it there when out of place.

The tapping attachment put on some drills is a great saving of labor, and if the self-tripping rig was left off would become more popular, as it is apt to make a man believe the entire affair is of no value, while it is only the trip which is so.

A short time ago the writer was shown a device for a tapping attachment to a drill press, or it could be used in the spindle of the machine if a backing belt was provided; it had the new feature of an adjustment for various sizes of taps which could be quickly varied, and its idea was to prevent breakage of taps by having some part of it let go before the tap; this is not a new idea, but the graded scale, if it may be so called, is, at least to the writer. This article came direct from England, and while inspecting and comparing it with a somewhat similar production, certain remarks were forcibly brought to mind concerning boasting, which appeared in this paper from the pen of a gentleman whose articles the writer has always read with pleasure and much profit, even as far back as 1872, when the aforesaid gentleman was masquerading as an English engineer in America.

It might, perhaps, be due to the cosmopolitan education and existence of the writer, which allowed him to acknowledge the superiority, in his eyes, of the English production, without a single pang or desire to bolster up the productions of his own country at the expense of his pocket, simply because it was the work of a fellow countryman, yet he hoped it was from his ability to distinguish better from good, and a desire to save his taps, that induced him to place an order for the English article, and order the return of the tool to its makers, as it was left on approval.

It seems strange to stop at Papin if you go back of Watt. At least Hero conceived the idea of using steam as a power. To return to Nature is the only safe way if you want to get at the root of things. We can say Gutenberg gave nothing new to the world in making movable type, as it is clear that tiger

tracks spelled "tiger" to the hunter as plainly as does type to us to day, and there is no question but the type was movable. The Nautilus shows us a boat with sails and self-contained power; a little ingenuity will leave man without an original idea. We are sure the diamond drill was used on the pyramids, and if the form of these structures gave the idea of the straight line engine, the writer fails to see why any less praise should be given its designer—is there less praise to be given Weston for his pulley block because the Chinese windlass showed the idea in a non commercial form?

It takes more than words to prove America's supremacy in mechanical arts, and to try to prove it by the liberal use of trade catalogues is, in the opinion of the writer, abortive, and it seems strange that anybody who believes in such supremacy, should go out of the country to select a water-wheel for an American enterprise, when the writer knows that an American wheel is being exported to Europe on account of its superior work, in the face of the fact that cheaper wheels are to be obtained there; it only goes to show that the American engineer will select the best in his opinion, no matter where it is found.

Boasting is not to be encouraged, but it really seems that in certain lines America has a right to be proud. Stevens made the T-rail, which form seems to be perfect; Pullman made riding on it a pleasure, and Westinghouse probably has saved more lives than all the doctors of the past twenty years by his brake, but in naming these men we do not detract from the name of John Stevenson. In general, the writer has found Americans ready to bow to intellect, and credit it wherever it belongs.

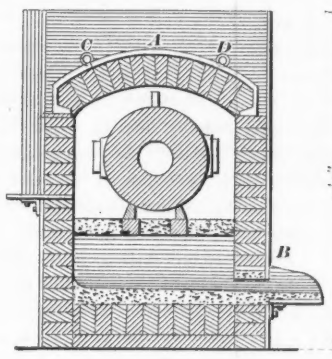


Fig. 3.

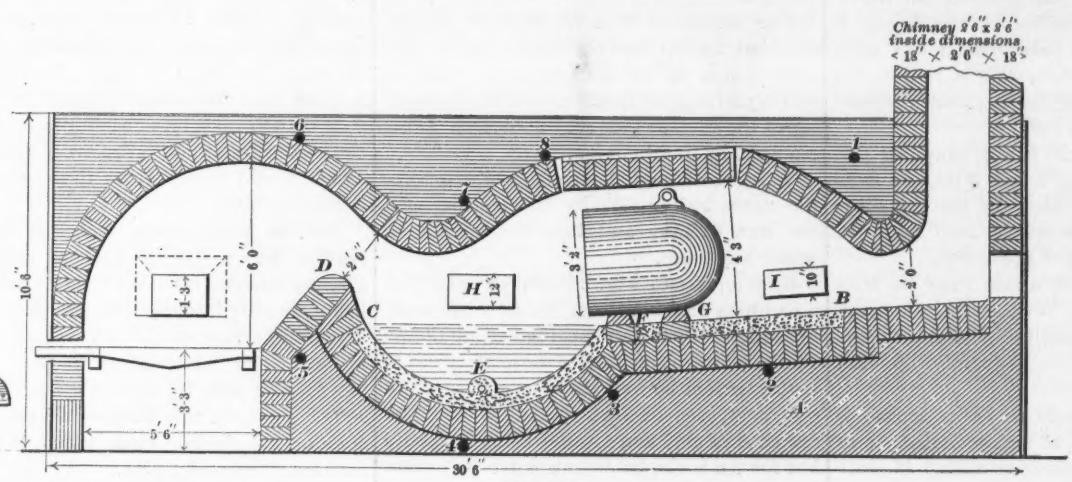


Fig. 2.

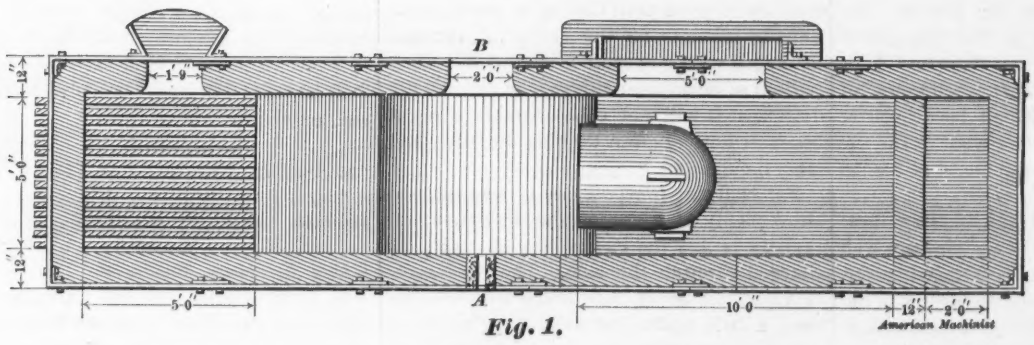


Fig. 1.

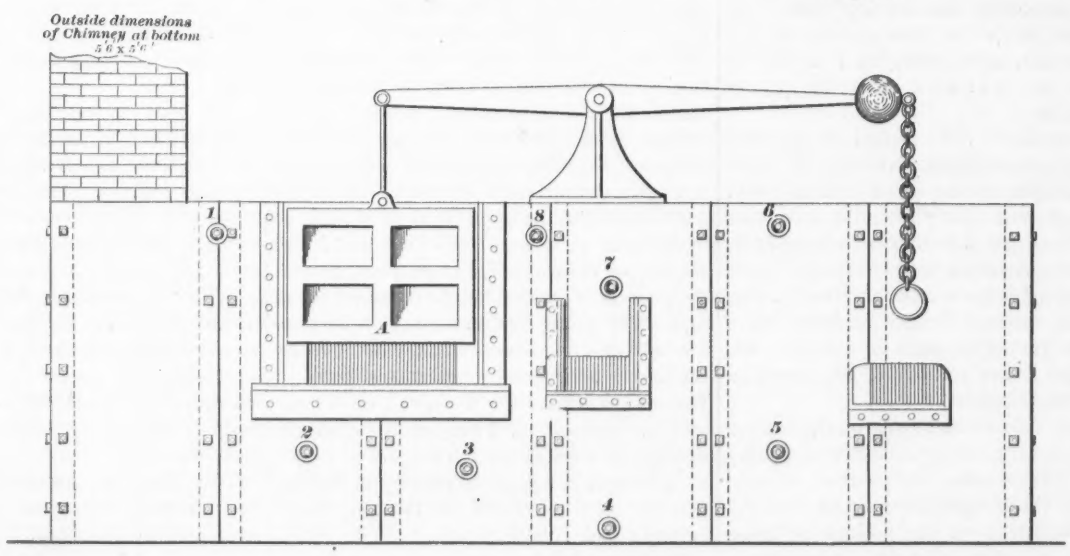


Fig. 4.

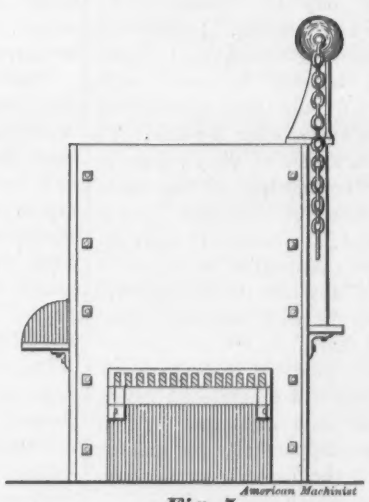


Fig. 5.

MELTING CAST IRON IN REVERBERATORY FURNACES.

Melting Cast-iron in Reverberatory Furnaces.

BY S. BOLLAND.

Reverberatory, or as they are more frequently called, "wind or air furnaces," to distinguish them from those worked with compressed air or blast, are not as commonly used for general purposes now as they were formerly, for manifest reasons, some of which it would, perhaps, be well to inquire into.

In the first place it is claimed that they are too expensive in their working, requiring, as they do, more than twice the amount of fuel that is needed in the cupola for the production of good hot iron; but an extensive practice has convinced me that even such considerations would have been over looked on particular occasions, if there had been a good reverberatory furnace in the shop.

Too frequently castings are needed which, if common justice was done to all parties concerned, ought to have been cast from the reverberatory furnace, and in the, sometimes, oft-repeated effort to produce iron of the desired homogeneousness in the cupola, the cost of production, in the end, has been very far in excess of what it would have been had the proper furnace for the job been on hand.

Another of the prime causes for this discontinuance is the great lack of knowledge manifested in their construction and management, owing to which failures have attended the efforts of quite a number of founders who have endeavored to establish their use, and they have been forced to abandon the enterprise and fall back, disappointed, to the cupola again.

This should not be the case, nor need there be any such giving up; the business can be learned, like any other, by hard application and industry, and no better incentive to this could be adduced than to inform all such as have failed in learning the art, that throughout the whole of Europe the reverberatory is as common as the cupola furnace is here.

Do not understand me as urging their general adoption in place of the cupola; in view of the latter's great utility such a proposition would be preposterous in the extreme; but I do maintain that if they were built and held in readiness for emergencies, which are constantly occurring, it would reveal a greater wisdom on the part of our leading founders.

It cannot be denied that the reverberatory furnace will yield a purer metal than is possible for the cupola to do, simply because it is melted separate from the fuel, and consequently cannot absorb its impurities; whilst on the other hand the iron in the cupola is charged in direct contact with the fuel, with the consequent result of being more or less impregnated with its impurities; this fact is incontrovertible, and speaks volumes in favor of the reverberatory, when absolutely clean iron is the desideratum.

Iron melted in the reverberatory furnace loses a portion of its oxygen during the process. This tends to harden by converting *graphitic* into *combined carbon;* hence the eminent adaptability of these furnaces for the production of iron suitable for guns, hydraulic cylinders, rams, heavy rolls, etc., as any degree of homogeneousness can be obtained by polling the molten iron in the reservoir after it has all melted, and at the same time allowing the full force of the flame to play upon its surface until the iron, by dipping test, shows the desired texture.

One great advantage claimed by the workers in malleable iron is, that iron melted in the reverberatory furnace anneals at a heat very much lower than would be required for iron melted in the cupola; this will in some measure compensate for the extra cost of melting in the former.

For the reduction of unwieldy masses of scrap iron, this class of furnace is indispensable, as any amount of this apparent drug can be reduced into good fluid iron with the greatest ease.

For the benefit of all such as are ignorant of the principles which govern the art of melting in these furnaces, it is needful to say that in all cases where it is desired to melt metals out of contact with the solid fuel, special combustion chambers or fireplaces must be provided, the metal being melted by the body of flame and heated gas acting upon its surface as it lays on the bed of the furnace.

To accomplish this effectively, the flame must be made to reverberate from the low vaulted roof of the furnace downwards, and the form of the roof associated with the velocity of the flame will determine what part, or parts, of the bed will receive the full force of the heat current.

This fact gives rise to numerous opinions as to the correct form to be given the inside of a reverberatory furnace for obtaining the maximum of efficiency, some favoring the method of placing the charge behind the bridge wall; others again maintain that the chimney end is the best for charging, because it is generally allowed to be the hottest; but however much they may vary in construction, the principles which govern, as noted above, are about the same.

The furnace represented by the illustrations accompanying this article is a very good one for general work, and very suitable for reducing or melting heavy lumps which would otherwise have to be cut up into smaller pieces before it would be practicable to melt them in the cupola.

The chief points in the representations have their dimensions figured; this will aid in arriving at a correct estimate of the proportions of the furnace shown. Its outside dimensions, exclusive of plates, are 30 feet 6 inches long and 7 feet wide. The whole structure is incased in wrought-iron plates joined together, as shown in plan, Fig. 1, and again by broken lines at Fig. 4.

The corners are held together with angle irons, and the principal anchors are those shown at Fig. 4, and marked from 1 to 8 respectively. These "chief" anchor bolts reach from one side to the other, passing through the structure at such places as are

best calculated to bind the whole firmly together, and, at the same time, are clear of all working parts of the furnace, as will be observed by referring to Fig. 2, where the position of each bolt is shown at figures corresponding to those marked on the side elevation, Fig. 4.

The amount of strain which this furnace is called upon to bear, owing to the intense heat and pressure to which it is subjected periodically, makes it imperative that not only the walls, but the foundation also, should be as substantially built as possible.

The foundation *A*, Fig. 2, can be built up solid of common material, up to the line of fire-brick, and in such form as will allow the fire-bricks when set thereon to incline from the chimney to the reservoir in a downward direction, as shown at Fig. 2, and it will be seen that all those from *B* to *C* must be kept six inches below what it is intended shall be bottom of the furnace after the sand bed has been formed upon it.

The bridge wall *D*, Fig. 2, must, in this case, be not less than 2 feet 3 inches from the face of the grate bars, and like the sides, roof and fireplace, must be built with the most refractory kind of fire-bricks.

The fireplace must in all cases be built the full width of the furnace to commence with; should it be thought desirable to contract its dimensions subsequently, the task will be an easy one.

The roof, throughout its entire length, is an arched one, and, as before stated, must be of fire-brick; whatever filling is done above the fire-brick arches can be of commoner material.

The chimney for such a furnace would need to be from 30 to 40 feet in height, surmounted with a damper, so arranged as to be easily controlled from the bottom; this is an important feature, as the draught is regulated altogether by the damper. It is hardly necessary to say that a chimney of this sort must be built with an inside course of fire bricks, and no matter what form the outlet from the furnace may be, it is best to build the chimney square.

The methods adopted for binding these chimneys are various, but as they are well understood by all masons accustomed to this class of work, it will not be necessary to describe them here. As to their dimensions, it is a common rule to have the inside area equal that of the air space in the grate, but these things can only be determined by actual experience and practice. I have seen good melting done in reverberatory furnaces whose chimneys, in some instances, were much smaller than the rule allows, and again, in other instances, when the chimney's area has been in excess of the air space in the grate, the melting has been all that could be desired. I therefore conclude that it would be the wisest, in all cases, to have the area of the chimney somewhat in excess of the fireplace, as in any case the damper will regulate the draught with certainty when the height is sufficient.

A very excellent mode of building chimneys is to have them as a separate structure, resting on a sole plate supported by four columns; this gives opportunity for making a connection with the furnace or furnaces from any direction which may be chosen.

There are two kinds of charging doors shown; the one at *A*, Fig. 4, is on the side, and covers a hole 5 feet by 4 feet, through which the iron, heavy and light, is conveyed when the charging is all done from the side aperture; the other is seen on the top of the furnace at *A*, Fig. 3, and covers a hole as wide as the furnace, 6 feet in length.

In all cases when the iron to be charged is heavy, the latter method is the most convenient. As seen, the doors are lined with fire-bricks.

The manner of building a furnace, here shown, admits of easy access to any part for repairs, for as all the connections are made with bolts (not rivets) one or more of the plates can be detached at the place where it is needed for making alterations or repairs.

Fuel is the all important factor for producing hot iron in reverberatory furnaces, as it is also in cupolas, and although numerous tests have been made with coke, hard coal, anthracite and charcoal, none seem to work so well as the soft bituminous coal of the non caking kind; it is the only fuel upon which the utmost confidence can be placed.

The importance of a good draught in these furnaces will suggest itself to the least observant, but it must be remembered that this draught will draw cold as well as hot air through the stock if there are openings left at any point for its ingress; this bad feature is to be avoided by all possible means, and this can only be done by incessant watching of the fire, always endeavoring to keep a full grate of live coal, and when clinkering must be done, let it be done quickly and well, and avoid making holes in the fire, through which cold air can rush into the furnace.

The inrush of cold air is to be strictly guarded against from whatever cause; for, independent of the dangerous tendency towards chilling the furnace, there is a possibility of the chemical nature of the iron being changed by its admission.

When the draught is strong enough to force the flame with a velocity sufficient to melt the iron quickly and hot, it need not be urged any more.

By referring to Fig. 2 it will be seen just how much of the bottom needs to be made up with sand; it starts on the bed at *B*, and continues down and around the reservoir to *C* If this bottom be well made with a preparation composed of eight parts fire sand, and one each of clay and ground coke, it should last for ten heats, providing it receives from one to two hours good firing before the first charge is piled in.

The breast seen at *A*, Fig. 1, *E*, Fig. 2, and *B*, Fig. 3, can be made after the manner suitable for a large cupola, but as the hole must be stopped until the tap is made, pains must be taken to fill the cavity all through its length with fire sand mixed with a small portion of coal dust; this can be easily withdrawn, as it will not cake together when it becomes hot. Before tapping be sure and close the damper.

For charging purposes it is advisable to allow plenty of room at the doorways; especially is this the case when all must be charged through the side. The first layer of pigs must be set lengthwise with the furnace, a little apart, the following layers in opposite direction, but leaving spaces between each pig for the free passage of the flame; in fact, open charging is to be observed, no matter of what nature the pig or scrap may be.

When the pieces to be melted are of more than ordinary magnitude, it is then in order to have an open top through which to lower them down with the crane; the cover for such an opening is shown in end section at *A*, Fig. 3, being simply a segment of the circle corresponding to the arch of the roof at that point, with internal flanges for carrying a course of fire-bricks built in on end; the rings *C* and *D* are for lifting the cover on and off with the crane.

The object shown as resting on the bottom represents a U. S. 13-inch mortar, weighing about 17,000 pounds. Preparation is made to sustain this weight clear of the bed, by setting fire-bricks on the bottom, to finish level with the bed when it is formed, on which to rest other blocks for carrying the load; by this means the flame can play all around the piece, and a speedy reduction of the mass ensues, if all is working right.

It will be noticed that considerable space behind remains unoccupied, all of which can be utilized if more iron than is contained in the mortar be needed; for, as before stated, this is the hottest part of the furnace.

All the iron required should be charged at the first, as it is not advisable to attempt the reduction of any additional stock immediately after the heat is down; such attempts are attended with disaster oftener than otherwise, because the furnace cools off considerably by the admission of *cold iron* and *cold air*, making it next to impossible to melt the second charge before the iron first melted becomes cold and useless.

The hole shown at *B*, Fig. 1, and at *H*, Fig. 2, is the puddling hole, and, as will be noticed, is directly over the reservoir. It is through this hole that the dipping is done for testing purposes; the skimming is effected through this hole also. It is very important that the molten iron be kept clean, as any accumulation of dirt or scum upon its surface acts like a shield, and interferes with the direct action of the flame upon its surface; this, of course, is as good as so much heat lost.

Another very important operation which is readily accomplished by means of the puddling hole, is the boiling of the metal, a process which becomes absolutely necessary when opposite grades of iron are to be mixed together, out of which it is desired to obtain a thorough blending of the whole; this is done by thrusting down into the molten iron one or more green saplings. This, of course, creates a violent ebullition throughout the mass, and usually effects the desired result, but this, as well as the other operations, must be done with the utmost dispatch, otherwise cold air will rush into the furnace in sufficient quantity to neutralize every good effect which should accrue from these several important agencies.

Another hole is seen at *I*, Fig. 2, which enables the melter to take an occasional glimpse into the interior of the furnace, and being directly in range with the bed, he can materially accelerate the process of melting by separating such pieces as are welding together, as also by breaking up the more refractory ones; this hastens melting by increasing the surface upon which the flame can more effectually play.

The old saying, "that a stitch in time saves nine," applies with more than ordinary force to the management of these furnaces. A careful examination after each heat will reveal small and apparently insignificant faults. If these are at once remedied, these furnaces will not only last longer in good condition, but, as a natural consequence of their superior efficiency, will also melt hotter and better iron.

LETTERS FROM PRACTICAL MEN.

Inertia and Momentum—A Word Wanted.

Editor American Machinist:

In your editorial of the AMERICAN MACHINIST of this date, "A Word Wanted," you express a desire for a term which will express quantitatively the resistance of inert bodies to being put in motion. There are already two such terms well-known to students of mechanics, viz.: 1, weight; 2, mass or weight divided by 32.2, the value of g at the earth's surface. Suppose we have a pound of metal resting on the surface of the earth, what is the resistance to its being put in motion vertically upwards at a very slow velocity? The answer, of course, is its weight, one pound. Suppose it is suspended from an overhead support by a long cord, or resting on frictionless balls on a frictionless track, what is its resistance to being put in motion horizontally? The answer is that it will depend on the velocity of the motion. The quantity of energy stored in it when in motion is equal to $\frac{1}{2} m v^2 = \frac{1}{64}$ weight $\times$ square of velocity in feet per second. If the velocity of the body is infinitely small it will require only an infinitesimally small expenditure of energy to put the body in motion. A 10,000-ton vessel which requires 20,000 horse-power of engine to keep it moving through the water at a speed of say 22 miles an hour can be towed about in the river by a small tugboat. It is evident, therefore, that no single term can express quantitatively the resistance of bodies to being put in motion which will give any clearer ideas of the subject than the two very satisfactory terms we now have—mass and weight.

The need for the new term, which you say has been realized by many of those who have attempted to master the theory of dynamics, is not felt to any considerable extent by those who have not merely attempted, but actually mastered it. It is not felt by students of mechanics who read modern text-books on the subject, in which rigid definitions are given to the terms used. Your correspondent has probably been befogged by reading some of the worst of the older writers on mechanics, or their copyists, who are badly mixed in their definitions, otherwise he would not say that a body in motion contains a force, nor that the "force" is called momentum; nor use such inexact expressions as "momentum is simply inertia at one end of the line," "momentum is inertia," etc.

Momentum, as defined by Rankine, is the product of the mass of a body into its velocity, or $m v$ or $\frac{W}{g} v$; but the term is now falling into disuse, as the word "energy," expressing the amount of work stored up in a moving body, or its capacity to perform work, represented by $\frac{1}{2} m v^2$, is more useful for ordinary purposes, such as expressing the energy in a moving fly-wheel, or in a cannon-ball in foot pounds or foot tons. As this term is rightly becoming disused, there is surely no use for the invention of a new term for "inertia at the other end of the line," whatever that expression may mean.

CRITIC.

Editor American Machinist:

In commenting on the communication of an engineer in your issue of July 28th, regarding the importance of more accurate knowledge of the laws governing the inertia of bodies than we now possess, you correctly state: "What seems to be wanted is a term which will express quantitatively the resistance of inert bodies to being put in motion."

There are few subjects in the domain of physics in a more unsatisfactory condition than that of inertia. It appears to be as much a perplexity to the physicist as it is an obstacle to the engineer.

Innumerable instances are cited of the effect of inertia, but we are given little information by which we can determine quantitatively the effect.

The subject will always be a perplexing one, owing to the seeming impossibility of determining the amount of distortion which takes place in a body when a force is applied to move it, and which distortion will vary with the nature of the substance.

The force which distorts a body does not operate to move it. This appears paradoxical, but it is nevertheless true.

When force is applied to a body there is always a portion besides that which causes the distortion which operates to move the body, but the fact remains that a given force cannot be absorbed in the distortion of a body and in giving it movement at the same time.

No body moves from a state of rest instantaneously with the application of the moving force, but it always acquires its motion by degrees. The force requires to become diffused through the mass; that is, each molecule must feel the effect of the force applied before movement can begin.

With very elastic bodies considerable distortion of a part of the mass may occur before the whole acquires movement, in which case the body will appear to have a different amount of inertia than in the case of another body of the same weight and of different elasticity.

This illustrates an instance in which, as your correspondent says, "inertia is not necessarily momentum."

According to the principle of momentum, when a force is applied to move two bodies of different weights in opposite directions they will begin their movement at the same instant, but will acquire velocity according to their respective masses; but Dr. Anderson observed that the mark made on a parapet by the discharge of a disappearing gun was sharply defined, and coincided exactly with the muzzle when the gun was fired. He argued from that fact that the projectile must have left the muzzle before the gun began its recoil; that is, the moving force had ceased to act when the gun began its recoil movement. This seems to substantiate the position maintained by many regarding the inertia of bodies—that the moving force is required to become diffused through the body before movement begins, and that time is a necessary factor in the determination of the inertia of bodies.

Those who have been engaged in designing machines having parts which were re-

quired to be alternately and rapidly put in motion and brought to rest have experienced the practical difficulty that inertia occasions. They understand the importance of having those parts as light as practicable, and, in counterbalancing them, to do so by means of springs and not by weights. Increasing the weight of a moving body increases both its inertia at the beginning and the momentum at the end of the movement.

I. MCKIM CHASE.

Editor American Machinist:

Your correspondent who wishes a new word coined to distinguish the inertia which opposes motion, and that which opposes a cessation of motion, has evidently not studied the meanings of dynamic terms, otherwise he should not have met with any difficulty. He says, "Bodies are inert. Being stationary, power is required to move them. Being in motion, power is required to stop them." . . . He should have used the word "force" in place of "power." Furthermore, the word "momentum" is no longer used in the sense in which he uses it, "energy" being put in its place, and the energy of a moving body is not its inertia. Inertia is the resistance experienced in changing the direction or the rate of motion, and may be expressed in pounds. Energy is the amount of work absorbed while the body was put in motion, and is expressed in terms of foot-pounds. Then, again, motion is a relative concept. A thing may be at rest in relation to one basis of observation and at the same time moving in relation to another basis. The same force that imparts motion in relation to one basis may tend to stop motion in relation to another basis. Dynamics cannot recognize even a specific difference between rest and motion, and a careful study of the precise meaning of the dynamic terms now generally accepted by authorities will probably convince your correspondent that the vocabulary is as complete as the present state of the science of dynamics requires. HUGO BILGRAM.

Philadelphia.

Editor American Machinist:

In the matter of your editorial, "A Word Wanted." I have made use of "fixidity," a word almost obsolete at present, but one, it seems to me, quite applicable. Wherever I have used it in instruction it has been at once understood by my students, the majority of whom are not up in the higher word usages and practices. I have also adopted it in connection with inertia in the book matter I have been preparing.

New York. WM. H. WEIGHTMAN.

The "Old Man" Goes to the Sea-shore.

Editor American Machinist:

I have been considerably interested in Jack Loftus, who manipulates the sixty-inch lathe in the lower shop. Not that there is anything particularly uncommon about Loftus, except when anything occurs that disturbs the harmony of the machinery for a few minutes, instead of folding his arms and searching for a soft place to lean against, he goes where the trouble is located and helps get things in motion again, or else he uses a piece of waste cleaning off the soiled spots on his lathe.

Then, too, I have noticed that when one of the cubs gets puzzled as to the best method to employ on some particular job with which he is not familiar, and the foreman is not near by, he quietly goes to the cub, their heads get together, Jack makes a few gestures with his arms, the cub brightens up and goes about his work, while Jack gets back to his big lathe in such a didn't-miss-you manner that it is hard to realize that he and the cub ever saw each other.

Then at the noon hour when most of the boys are flippantly roasting each other and bolting their lunches, Jack puts his meal out of sight with deliberation and enjoyment, and is debating something with other shopmates.

While he has some decided opinions of his own, too, he carefully listens to those of others, and gives and takes in argument with the same deliberation and pleasure that he masticates his food.

But I have noticed a new wrinkle in Jack during the past four months and mentioned it to Brailey, the foreman over that department, but he seemed to think Loftus was a sort of "crank," "so different from the rest of the men, you know," said he.

By the way, I am not perfectly satisfied with Brailey as a foreman. He is ambitious to get on and all that, but he is not my ideal; he is too much of a plunger, and I have to take excuses too often instead of results. I have tried to discover the proper niche in mechanical work where he would be suitable, and where I can place him without destroying his ambition.

But to get back to Loftus. Jack got into a habit of talking to himself, shaking his head, and then hitting some inoffensive casting a vicious blow with his hammer when he would partially regain his normal condition.

Matters came to a focus two weeks ago when he came in and said he wanted to "talk" with me. He said, "I want to get off for about two weeks or ten days; I've spoken to the foreman, and he says you can't spare me; now I want to have my say and then you can have your say. Probably you have noticed on your going home from the shop evenings that little woman and the two babies sitting on the door step of the little house on the corner of B street. Well, they are mine, as we call it, and I have a scheme. I know a man who went down to the sea-shore last summer and got good board and lodging for only one dollar a day, so I have held back all my overtime and extras for the past four months, and I have sixty dollars that my wife don't know of; I am going to take her and the babies to Rockaway and let them roll in the water and dig in the sand while the sixty lasts, and see what the effect will be. I've written to a Mrs. O'Brien for board and made all arrangements. I don't imagine that we will have rooms en suite with bath attached; neither will we be served at tables by servants of polished ebony with white apron trimmings, but we will have an opportunity to see the ocean and taste the saltiness thereof and forget, as it were, all about belts and pulleys, and the daily grind of shop and household duties, and see if things won't go easier after we come back. What do you say, do I get off ?"

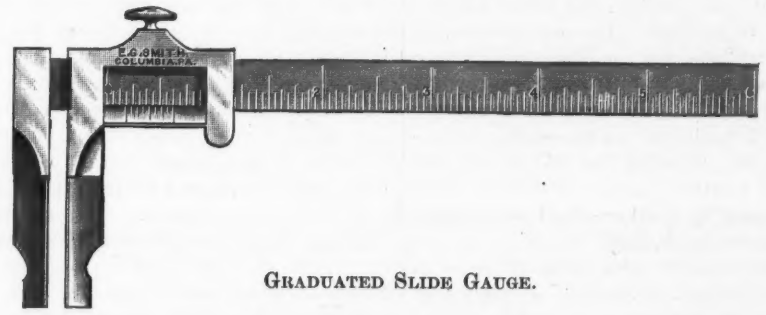
I had noticed the little woman and two babies as Jack expressed it, although one of the "babies" was a sturdy little chap of five years whose sole aim in life seemed to be to get the family cat hung on the front gate. I recalled the faded, tired look on the face of the little woman as she talked baby talk to the pale restless infant in her arms while awaiting the husband's evening home coming.

Jack had never gazed upon the ocean and I had. Judging from my own experience in days gone by I did not think his "sixty" would go very far, but I was interested in seeing the experiment worked, so I said: "Jack, your scheme looks so good that you can lay off while the sixty dollars holds out, and I would like also to invite myself to go along with yourself and Mrs. Loftus on this seaside outing. It may be beneficial for me also to commune with nature instead of mechanics for a few days; would I intrude ?"

Jack didn't faint away at my proposition, but recovering from the stagger it gave him, I was invited. We arrived at Rockaway on Thursday and found Mrs. O'Brien, notwithstanding the name, to be a rather cheerful woman of Connecticut Yankee stock, who kept the table loaded with good wholesome food and kept gallons of pure sweet milk for the babies to drink in her kitchen, while her husband was a jovial son of Erin, whose jokes kept everything lively. We rolled in the brine and the children burrowed in the sand after sand crabs until the baby was the color of a beet, while the five-year old looked like a Turk and had an appetite like an ostrich. Loftus spent the hours when out of the water sitting on the beach gazing oceanward until his eyes bulged out like opera glasses, while his timid little wife hunted shells and odd sea curiosities.

I didn't put in all my time in close companionship with him, and at the end of a week, when I suggested that probably they might find added pleasures spending the afternoons and evenings among the museums and concert halls, the flying Dutchman, the razzle dazzle, roller coaster, or as O'Brien puts it, "the roundy-go-boundy," and the hundred other attractions that take nickels from our pockets, Jack fired up and said, "Old Man, see the color in that woman's face ? See those two kids? That's all we want; I can get all those other rackets at home if I want 'em; I came here to forget the earth and have my family enjoy salt water, sand and tan; we are doing it great."

I bothered him no more, but helped the two cherubs build sand castles and paddle in the breakers until the tenth day, when Loftus packed his grip-sacks, and, taking the two babies in his arms, said, "Let's go." Bidding our generous hosts adieu we came through the great metropolis, and in the evening, after he had stowed his treasures away in their berths, he came into the smoking room of the sleeper where I was enjoying my cabbage leaf without sauce. As I gave him a cigar I asked, "Jack, how much over the sixty did it take ?" "Two dollars and thirty cents less than sixty," he replied. "Pretty good scheme, hey ? Think I'll take in the mountains next year."



GRADUATED SLIDE GAUGE.

Loftus showed up Monday morning as usual; instead of his previous "queer" actions there was a twinkle of contentment in his eyes Undoubtedly his scheme was a paying investment.

I believe every man and boy around the plant has been up to the cottage on B street, "hefted" the boy, admired the baby and complimented the blushing Mrs. Loftus on her improved looks. I also understand there is to be a general hegira to the sea shore next summer by the employes of this firm; from general manager down to the youngest cub. I also notice a slight improvement in both quality and quantity in work produced in the shop. Yes, it paid.

"THE OLD MAN."

Graduated Slide Gauge.

We present an illustration of a tool intended to be used as a caliper and general gauging instrument, in which the vernier principle is made use of to accurately measure the 128th part of an inch.

The beam of the caliper is graduated to 16ths, and the vernier scale on the sliding jaw divides a space of $\frac{7}{16}$" into eight equal parts, thus giving 128ths of an inch, which are readily read off with accuracy.

The outside of the jaws at the extremities are ground just $\frac{7}{16}$" in diameter, so that by taking the opposite end of the vernier scale for the initial point and reading in the opposite direction, inside measurements are obtained with equal accuracy, without the necessity for using two scales or making allowance for the thickness of the jaws.

All parts of the gauge are made of steel and all wearing parts hardened, the jaws being accurately ground parallel and at right angles to the beam. A spring under the clamping screw keeps the sliding jaw in uniform contact with the beam.

No mechanic who has ever used a slide gauge will need to be told their peculiar advantages for many kinds of work, and this one, with its facilities for "splitting 64ths," ought to find favor, especially with those who do not like the decimal system of division. The calipers are made in five sizes from 4" to 12" long by E. G. Smith, Columbia, Pa.

A Female Stage-driver.

A peculiarly nervous little woman, with dark auburn hair and flashing black eyes, is often registered at the Grand Hotel in this city. She is Mrs. H. J. Langdon, of Lassen County, the woman stage-driver of the Sierras; but she is more than a driver of stages; she is an owner. Her stage lines extend for several hundred miles throughout the mountains, and she owns scores of horses and vehicles, and carries the United States mail as well as hundreds of passengers.

Her husband died a few years ago, and she took hold and managed and extended the business aforesaid. Mrs. Langdon has taken many mail contracts from the Government, and is well known at Washington, D. C., which city she often has occasion to visit in connection with her mail contract. Recently she had some correspondence with Postmaster-General Wanamaker in regard to his method of awarding contracts, in which she expressed herself in a manner to attract the attention of the entire country.

Mrs. Langdon is reported to be as good a judge of stock as any man in the stage business. She knows also the opportune moment when to grease a wagon, oil harness, and generally to keep in touch with the stage business, so as to make it successful.

Her stage lines extend over some of the ruggedest routes in the Sierras and again across plains, like those about Susanville. Plumas County has several of Mrs. Langdon's lines. She delivers mails and passengers promptly, and by reason of her skill in taking contracts and her ability in executing them has become noted for her pluck and enterprise. She is said to be an excellent whip, and to be able to manipulate the lines of four or more horses about as easily as the famous Hank Monk used to do on the old Geiger grade.—*San Francisco Examiner.*

A dispatch announces that no more oil-tank steamships would be allowed to pass through the Suez Canal. At the Standard Oil Company's office, 18 Broadway, it was said that the Standard Company had never sent oil to India by way of the Suez Canal.

The company had made application to the directors of the canal some time ago for permission to send oil steamships through there, and the decision has just been given adversely, as oil steamships were considered too dangerous.

Oil in cases will in the future be sent around the Cape, as in the past, and the decision of the canal directors will not affect the market any, nor will the Russian oil dealers gain any advantage from it, they say. Case oil is always carried to India in sailing vessels, as it is much cheaper.

The government has ordered built for exhibition at the World's Fair at Chicago a postal car equipped with all modern improvements, as a part of the United States postal exhibit. A portion of the sides of the car will be left open, and so arranged as to allow visitors to have a clear view of the interior without going inside.

Two double-decked ferryboats, with fore and aft screws, have been contracted for by the Central Railroad of New Jersey Company, with the Harlan & Hollingsworth Company, of Wilmington, Del., who expect to have the boats completed by January 1, 1893. The boats will be 158 feet over all, 54 feet wide over the guards, and 32-foot beam.

It is stated that secret instructions have recently been sent to the managers of all the Russian railways not to enter into contracts with foreign firms, nor to admit foreigners into their service.

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CONTENTS.

	PAGE.
A New Twenty-four-inch Engine Lathe	1, 2
Spiral Springs. By J. Begtrup	2
A Study of Fly-wheels By Leicester Allen	2, 3
Sperry's Micrometer Scale	3
Universal Radial Drill Press	4
Some Remarks. By W. D. Forbes	4, 5
Melting Cast-iron in Reverberatory Furnaces. By S. Bolland	5, 6
Letters from Practical Men: Inertia and Momentum—A Word Wanted. By Critic, I. McKim Chase, Hugo Bilgram and Wm. H. Weightman .. The "Old Man" Goes to the Sea-shore. By "The Old Man"	6, 7
Graduated Slide Gauge	7
A Female Stage-driver	7
A Department of Mechanics and Engineering	8
An Eight-hour Day on Government Work	8
George Sidney Percival	8
Questions and Answers	9
Cutting Accurate Screws—Spiral of Milling Cutters. By A Mechanic	9, 10
Manufactures	10, 11
Machinists' Supplies and Iron	11

A Department of Mechanics and Engineering.

The control of the proposed new ordnance factory on the Pacific coast seems to be somewhat of a bone of contention between the army and the navy departments. It is proposed to make guns there for both the army and navy in the same establishment, to be controlled jointly by the two departments. It has been argued by some officers, who might be supposed to know something of the matter, that this arrangement will be unsatisfactory, since the necessary differences between guns with their mountings intended for land service and those for use afloat would make it inadvisable to construct them in the same establishment. Very few of those who know most about manufacturing operations or the making of guns would agree with this view, and it seems that Congress did not.

Our own opinion is that there would be considerable advantage in taking all mechanical operations out of the control of both the navy and army. We can see no reason whatever why guns should be made under the supervision of either naval or army officers. The making of a gun is a mechanical operation pure and simple, the same as is the making of a gun lathe, a planer, a traveling crane, or an engine, and there is no good reason why these mechanical operations should not be under the supervision of mechanics who understand the business, and who need to know nothing whatever of military or naval affairs. If the government wishes to make guns let it make them in establishments devoted to that purpose, and manned, not by military men or naval officers, but by mechanics skilled in the art of gun making, and whose business it is to make guns. The management of these establishments can then be intrusted to men whose business it is to direct manufacturing and industrial operations, and the responsible positions can be open to any and all citizens possessing the necessary qualifications, whether graduates of West Point or Annapolis, or of other schools, or of shops where such work is done.

In this country, priding itself upon its advanced mechanical practice, we can see no good reason for such an office as the Secretary of Agriculture, for instance, which does not as well apply to such an office as the Secretary of Mechanics or of Manufactures, and such an officer might properly have charge of all purely mechanical work done by the government.

It might not be practicable to bring the steam engineering department of the navy under such a separate management, but few can doubt but that, if it were possible, it would result in much good to the engineers of the navy, and to the service. The engineers would then have just such rank and standing as properly belonged to them as engineers, and would have none of the hoary traditions nor red tape of the navy to contend with in securing recognition of their rights, all of which would be a good thing for the service.

Those officers who are in either the army or navy, and whose talents run in the direction of mechanics or engineering, usually dislike red tape, and would gladly dispense with it. They would probably be much better off if in a separate department of the government, devoted to mechanics and engineering, and wherein they could be rated and estimated as such, without regard to military rank.

Until something occurs to change our views we are in favor of a department of mechanics and engineering, within which all mechanical work done by the government may be carried on under the supervision of mechanics and engineers. Then let the other departments—the navy, the army, or what not—apply to this department for what they require in the way of mechanical structures.

There is much more that might be said in favor of this plan, and probably also something that can be said against it, but lack of space forbids its further discussion here at this time. It is a matter worth thinking about, however.

An Eight-hour Day on Government Work.

Some legislation enacted at the recently closed session of Congress respecting the eight-hour day seems likely to result in considerable complication, and may be found to be entirely impracticable. The new law makes it illegal for any mechanic or laborer to be employed on government work more than eight hours during any calendar day except in cases of emergency, the government to be the judge as to when the justifying emergency has arisen. And working overtime with extra compensation therefor is not allowed.

This would be all right in an establishment devoted entirely to government contracts, but any one who knows anything of shops knows that it would be practically impossible to carry this out in an establishment where private contracts were being filled at the same time, these latter contracts being taken at competitive prices. Of course it is not absolutely impossible, but when we say that it is practically impossible we mean that it cannot be done without such a great disturbance and disarrangement of orderly and concerted operations throughout the establishment as to greatly increase the cost of both the government and the private contracts. Not only will the cost be increased beyond what it would be in an establishment working ten hours per day uniformly, but it will be much more than it would be in an establishment working uniformly eight hours, so that it is safe to say that with few exceptions, those establishments who propose hereafter to enter into competition for government contracts will either expect to evade the provisions of the law with respect to some parts of the work, or arrange to work eight hours per day uniformly on all work, both government and private.

If the latter alternative is accepted, then there will be a fair chance to test the matter of the comparative efficiency of establishments working ten and those working eight hours. That this efficiency will be reduced in proportion to the shortening of the hours, or twenty per cent., we do not believe, though it is of course apparent that the production of many machine tools will be reduced very nearly if not quite that much.

Whatever the effect of the new law upon the cost of work may be, the government will, of course, have to foot the bill, and the tendency being undoubtedly toward shorter hours of labor, we know of no one who is better able, or whom it is more proper should risk experiments in this direction. Very much of the government work is now done upon a basis of an eight-hour day, and with the present large amount of work being done for the government, it can exert a strong influence toward the universal adoption of eight hours as a day's work, and the adjustment of prices to suit the new conditions so far as necessary.

The law cannot, of course, apply to contracts already let, and with those on which bids are yet to be asked all bidders will understand the conditions, and can govern themselves accordingly. Thus the experiment may turn out to be useful, and may go very far toward solving the shorter day problem without inflicting injury upon any private manufacturing concern, except in so far as it may tend to prevent bids by those who would otherwise be able to put in bids, and even these may find their compensation in the lessening of competition for private contracts, owing to the forced withdrawal of those who have chosen to accept government contracts, and arranged their establishments accordingly. We hope to see the shorter day question settled soon and settled right, and think this law will help towards such a settlement. By improvements in machinery and processes, man's productive powers have been and are constantly being greatly increased. There is much ground for the contention that one result of this should be shorter hours of labor, but the main difficulty of the problem is to bring this about so far as practicable in such way as to avoid friction and injustice.

George Sidney Percival.

By the death of Mr. G. S. Percival, the mechanical engineering world loses a member of uncommonly brilliant promise. He was a "Junior" member of the American Society of Mechanical Engineers, of the First Battalion Naval Reserve, and a graduate of the Columbia College School of Mines.

At the time of his death he was employed by Westinghouse, Church, Kerr & Co., of this city, who pay the following tribute to his memory:

OFFICE OF WESTINGHOUSE,
CHURCH, KERR & CO.,
17 CORTLANDT STREET, August 3.

He was in our employ for about two years, and was a most faithful and efficient man. He was one of the few young men who had a thorough engineering taste and knew how to apply it in useful ways. He was one of the youngest men on whom we ever placed real responsibility, sending him out frequently considerable distances to erect large and valuable work without assistance, and his work was always intelligently and successfully completed. Among other things, we might particularly mention his disposition to prosecute his work regardless of time, frequently remaining in our office many hours overtime, without being requested so to do, and in some instances working all night when he knew the importance of completing certain drawings or estimates.

On his return from the cruise of the Naval Reserve with a severe cold he insisted on beginning work at once, which disposition was in line with his faithful habits. He had our utmost confidence in every respect, and his manly qualities and good disposition made him warm friends, not only among his employers, but wherever he went.

The news of his death produced such an effect upon all of us that scarcely any business could be transacted on the day we received the word, and such remarks as we can make will hardly state our appreciation of him and our grief over the sad loss.

(Signed) WALTER C. KERR.

The country has been filled with amateur astronomers for some days past, who have been busy in making and announcing—especially announcing—the most wonderful and startling discoveries regarding the planet Mars. Columns of newspapers have been taken up by the speculations of those whose imaginations are more powerful than any other mental quality they possess, and by interviews with men who have made more or less reputation for themselves as "scientists," by pretending to predict the weather, the coming of severe storms, upheavals of nature, etc., the distinction between these charlatans and astronomers being not too distinctly understood by many people.

In the midst of the excitement caused by the fact that some people seemed to believe that we were about to open up communication with the inhabitants of Mars, Professor Holden, of Lick Observatory, was cruel enough to say: "There is absolutely nothing to be said about our Mars observations from night to night, or about our observations for the whole year even, until after the work has been gone over with care, and a map made of our results, which will take until October next at least." A contemporary says: "This depressing proclamation came at the very moment when several journalistic astronomers, who were bringing to the subject the unbiased attribute of simple ignorance, had discovered that Mars was inhabited, and had mapped out its surface with canals, snow-capped mountains, and seas, and were in a fair way to find cities and railways, and, possibly, newspapers and telegraph poles within a few days."

It is more reasonable to suppose that some of the other bodies of the solar system support some form of life than to suppose that our little earth is the only planet inhabited by living beings; but the matter must probably long, if not forever, remain one of pure speculation.

Foresight is a very valuable attribute of the human mind—a fact which is illustrated

by an item which is now going the rounds of the papers, to the effect that Mr. George Westinghouse, of Pittsburgh, escaped with his life in a recent railroad accident only because he was in his own special car, which is constructed so much stronger than the cars in which the other people were riding, that it was comparatively uninjured. He is said to have remarked several years ago to a friend, that he "traveled about so much that he was sure, sooner or later, to get into a wreck, and when he did he wanted to be in a car that was as strong as possible." The friend added that "Mr. Westinghouse's foresight probably saved his life." We relate the incident so that those of our readers who are not possessed of foresight of their own may take advantage of Mr. Westinghouse's foresight, and immediately order specially strong private cars in which to do their traveling. We shall not order ours yet awhile, because it occurs to us that something else is needed beside foresight in such a matter as this - something in which we are painfully lacking.

No one will ever know just how much or how little real benefit natural gas has been to manufacturers as such, but certainly considerably less than it would have been if its benefits had not in so many instances been so greatly over-estimated and discounted by the inevitable land speculator. But, at any rate, it seems now to be likely that builders of air compressors may be benefited by the partial failure of the supply, since in Ohio the experiment is to be tried of using large pumps, which are to draw out the gas from the well, and force it through the mains at sufficient pressure to make it available where it is to be used, this being in many cases at considerable distance from the wells. It is said that the experiment is first to be tried by the Ohio company, with pumps having a displacement of 13,000,000 cubic feet in twenty-four hours.

One effect which seems likely to result from this is the compelling of owners of other wells in the vicinity to also use pumps, for it is probable that reducing the pressure very materially in one well will somewhat affect the flow from other wells piercing the same rock.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(341) C. H., Chicago, Ill., writes: I would like to know if there are any reversing engines with an automatic cut-off valve gear in existence. *A.*—We do not know of any, and we doubt if such are needed. 2. Have the modern engines on large ocean steamers an adjustable cut-off? *A.*—Yes.

(342) M. B., Atlanta, Ga., asks: Do you consider a 3½-inch valve sufficiently large for ammonia pumps 15x30 inches, making 75 strokes per minute? The same as are used on a compression side of an ice machine. *A.*—If the area of the opening in the valve is equal to that of a circle 3½ inches diameter it is large enough.

(343) C. W. K., Muncie, Ind., writes: Please inform me through your columns where I can get a book treating upon a system of classifying tinners' rivets, giving the micrometer sizes of wire and the number of rivets per pound. *A.*—We have not seen such a book, and we doubt if one is published.

(344) F. W. S., Vermillion, S. D., writes: Kindly inform me of the usual, simplest and most accurate methods of determining the heat value of fuels (coal, gas and oil) by chemical analysis, or where can I find a full account of these? *A.*—Probably the book treating on "Fuels, solid, liquid and gaseous, their analysis and valuation," for the use of chemists and engineers, by H. J. Phillips, F. C. S., will give you the information you seek.

(345) A. D., Lynn, Mass., writes: I wish to draw some cups like sketch, which are ¾" diameter, ½" deep. The material is sheet brass .02" thick. Is the depth too much for the diameter, and what will be the approximate diameter of the blank? *A.*—The depth is by no means too great, and much deeper cups could be drawn if required. The diameter of the blank will be, approximately, 1.43", provided the thickness of the stock is not changed in drawing.

(346) T. J. B., Starbuck, Wash., writes: Please explain through your columns the way of getting the length of a reach rod on a locomotive. *A*—The practical way of getting it is given in answer to Question 327, in our issue of August 4, current volume. For new work the length of reach rod should be given by the draftsman. Years ago the lengths of many rods on a locomotive were obtained in the shop by actual measurement, but this practice does not pay, and should be condemned

(347) C. D., Chicago, Ill., writes: On account of an argument I had the other day I would like to know if 21-inch I beams have not been rolled in America. If so please state in which mills these have been rolled *A.*—We do not see this particular size in any of the catalogues furnished by iron and steel manufacturers, as the depth does not increase by inches for deep beams; the nearest size we can find is 20 inches. Undoubtedly they can be rolled in this country, as steel I beams 24 inches deep have been rolled here. You can obtain these from any of the large mills.

(348) X. Y., ——, Ill., writes: I have been informed through what I consider a good source that the capacity of a smoke-stack can be increased several times by placing in the flue before it enters the chimney a box, or by changing the flue to a zig-zag form. If I had not been informed to this effect by what I consider reliable authority, I should not consider it for a moment, as it seems to me against all theory and experience. I desire to increase the capacity of our smoke-stack, but before going to this trouble and expense would like to ask you if so doing will accomplish the result, and if you have any knowledge of any one using this device? *A.*—We do not know of any one using it, nor do we believe in its utility; in fact, in our opinion it will do more harm than good.

(349) J. K. H., Philadelphia, Pa., writes: I am building a steeple compound; cylinders, 4 and 7 inches diameter; stroke, 5 inches. The engine is to run non-condensing, cut off steam in the high-pressure cylinder at ¾ stroke; at what point should the cut-off occur in the low-pressure cylinder? I think the low-pressure valve should cut off at full stroke, because otherwise there would be a pressure between the high pressure piston and low-pressure valve. *A.*—The back pressure will not be uniform throughout the stroke in the high-pressure cylinder in any case; whatever little difference the cut off in the low-pressure cylinder may make to it will not be hurtful. The cut-offs should be arranged so as to equalize the work in both cylinders as near as possible. 2. What should be the distance between the eccentric rod pins in the link, and how do you design one? *A.*—The distance between the eccentric rod pins should be equal to about 2½ times the travel of the valve. The method of designing a link is explained in our issue of February 26, 1887.

(350) H. M., Butte City, Mont., writes: Inclosed please find a set of indicator cards from a Corliss compound engine taken with an arc indicator. Please tell me the cause of the pencil dropping so quickly on one end and not on the other. Also give the mean effective pressure. *A.*—The difference in the expansion line at the ends to which you refer is due to the arc described by the pencil. We cannot give you the mean effective pressure because you did not give the scale of the indicator. 2. Do you consider the arc indicator to be as good as a straight line indicator? *A.*—We cannot express an opinion as to the respective merits, nor recommend one instrument in preference to another. 3. The high-pressure cylinder of this engine is 14 inches diameter; low-pressure, 24 inches diameter; stroke, 42 inches, tandem type; steam pressure, 98 pounds; vacuum, 18 inches; 81½ revolutions per minute; water per hour, 2,052 pounds; coal, 300 pounds per hour; temperature of feed water, 140 degrees; temperature of hot well, 120 degrees. The condenser has 226 tubes, 8 feet long, ¾ inch diameter; air-pump, 8 inches diameter, 6 inches stroke. Are the condenser and air-pump large enough for the engine when run at full capacity? *A.*—The condenser is large enough; the air-pump is too small.

(351) W. L., New York, writes: In reading your article relating to the brake test of the White & Middleton gas engine we observe that you give 5.98 H. P., the scale beam showing 34 pounds. Are we to assume from that that the scale should show say about 6 pounds to the actual brake H.P.? We assume that the size of the pulley does not matter so long as the speed is kept up to an average of 215 revolutions per minute, and that the balanced brake lever is 4 feet 3½ inches from center of engine shaft to the point of contact with the scale beam. *A.*—In this kind of brake the work absorbed per minute by friction is equal to the work in foot-pounds per minute at the end of the lever arm, and when the length of this arm and the pressure at the end of it is known, the horse power is obtained without taking into account the diameter of the pulley and the pressure of the friction blocks on the same. The formula for computing the horse-power is

$$H.\ P. = \frac{6.2832 \times L \times N \times P}{33{,}000},$$

in which L denotes the length of the lever arm in feet from the center of shaft; N the number of revolutions per minute; P the pressure in pounds acting on the end of the lever arm. Substituting for the symbols their values you will obtain 5.98 H. P. You are correct in assuming that it will take about 6 pounds pressure at the end of the lever for an actual brake horse-power.

(352) W. G., Philadelphia, Pa., writes: Please give me a formula for computing the length of one-inch pipe for heating a room 16x20 feet and 7 feet high. *A.*—In computing the heating surface, the kind of building must be taken into consideration, for a greater amount of heating surface will be required for a poorly put up than for a well-constructed one. The windows are the first and most considerable item; the kind of plaster on the walls, whether the building is exposed or sheltered, whether the whole house is to be heated, or only part of it, and what the building is used for, should receive due consideration. A rule for heating by steam frequently used is as follows: For direct radiating surface, add together the area of glass in the windows in square feet, the volume of air required to be changed per minute, and one-twentieth of the external wall and roof. Multiply the sum by the difference between the required temperature of the room and the minimum temperature of the external air; divide the product by the difference between the temperature of the steam in the pipes and the required temperature of the room. The quotient is the required radiating surface in square feet. The volume of air required to be changed per minute is variously estimated from 3½ to 20 cubic feet per minute per head of inmates in ordinary good health. It seems to us that you will require about 40 square feet of heating surface. Assuming that each pipe is 2 feet long, 1¼ inches outside diameter, then its heating surface will be .65 square foot, and the number of pipes required $\frac{40}{.65} = 61$, making in all $61 \times 2 = 122$ feet of pipe.

(353) C. W. W. S., Syracuse, N. Y., writes: Please answer the following: What is the center breaking load of a cylindrical steel bar 6 inches diameter and 39 inches long between supports? Please give formula by which you work this, and also for a square bar. *A.*—The formula for computing the center load which will break a round steel bar supported at the ends is,

$$W = 4 \times \frac{S \times d^3 \times 3.1416}{32 \times l}, \qquad (a)$$

in which W denotes the weight in tons; S, the stress on the fiber most remote from the neutral surface; in this case it may b taken at 50 tons; d, the diameter in inches; l, the length betweeen the supports in inches. This formula can be reduced to

$$W = \frac{19.635 \times d^3}{l}. \qquad (b)$$

Substituting for the symbols in formula (b) their values, we have

$$W = \frac{19.635 \times 6^3}{39} = 108.74 \text{ tons for}$$

the breaking weight. For finding the center breaking weight of a square steel bar supported at the ends we have the following formula:

$$W = 4 \times \frac{S \times d^3}{6 \times l}, \qquad (c)$$

in which d denotes the depth of a side in inches; the other symbols denote the same quantities as before. This formula may be reduced to

$$W = \frac{33.33 \times d^3}{l}. \qquad (d)$$

Substituting for the symbols in formula (d) their values we have

$$W = \frac{33.33 \times 6^3}{39} = 184.6 \text{ tons for the}$$

center breaking load. Comparing the foregoing formulas it will be seen that for finding the breaking load for round bar we may first compute the load for the square bar, and then multiply the result by .589. For instance, we have found the breaking load of the square bar is 184.6 tons, then $184.6 \times .589 = 108.72$ tons, which gives us the same result as found by formula (b). The stress S varies, of course, with the quality of the steel, and unless we know the correct value of S the result of the above computations must be taken only as very close approximations. The weight of the bar should have been taken into consideration, but in cases where the distance between the supports is comparatively short, as in this example, it may be omitted without making any serious difference in the results.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant Gear Wheels, Gear Cutting, page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Ideal Drawing Stands. M. C. Hammett, Troy, N.Y.

A. D. Pentz, Consulting. Tools. Elizabeth, N. J.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Automatic Gear Cutters. Best in the market. Superior Machine Works, 103 Canal St., Cleve'd, O.

Pulley lathes, most efficient offered. Ohio Machine Tool Works, Cincinnati, O.

J. S. Thurman, M. E., Indianapolis, Ind., Expert Patent Solicitor. Inventions Perfected.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th St., N. Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C Bullock Mfg Co., cor. Canal and Washington Sts., Chicago, Ill.

Patterson, Gottfried & Hunter, Limited, 146-150 Centre st., New York, are putting on the market a new alarm speed indicator. Send for circulars.

25" / 32" / 37" / 42" — "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 206 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Cutting Accurate Screws—Spiral of Milling Cutters.

BY A MECHANIC.

By a great many people, machinists and others, it is thought to be a difficult thing to correct the pitch of a screw. Speak to, I will say nine out of every ten machinists about the matter, and they will at once imagine you are thinking of a wonderfully fine piece of work.

Most people have considerable confidence in the accuracy of the average lathe lead screw, and are almost willing to swear by it; but in a great many cases if these screws were put to a close inspection the confidence would be considerably shaken.

A case of extreme confidence in the accuracy of a screw on a milling machine was brought to my attention by Mr. Gay, of F. J. Gay & Co., manufacturers of milling cutters, Providence, R. I. An order was received for a gang of formed cutters to mill fine-toothed racks in lengths of 12" at one cut. The customer claimed that the job should be done in such a way that there would be no perceptible error, and seemed to think that a sample rack, which he had cut on a milling machine with single cutter and indexed for every tooth, was almost perfect.

Mr. Gay told him he could make such a gang of cutters with nowhere an error of over .001 or .0015, and that he thought this was as near as any milling machine could be depended upon to cut. To settle the mat-

ter they inspected the sample rack and found it out .005″ in 12″, which was probably the error in the screw in that length. Of course all screws are not particular, but I believe in every machine shop, where they pretend to do accurate work, there should be at least one lead screw as near as .001″ or .002″ in 12″.

It is not such a very difficult thing to make, or at least it should not be if it is gone about right. Almost any machinist who is used to fine work can cut an accurate screw to within this limit by the method I propose to show here, which was shown me by a friend. I do not pretend that this is a new principle, but only a way of applying an old principle that is well adapted to the ordinary run of engine lathes.

In Fig. 1 *A* is to represent the back end of lathe bed, *D* is the lead screw, and *B* the box, which in this lathe takes the thrust of screw in each direction.

I made a new box in order to apply this rig with the extension on base at *O*. This box is counterbored and internally threaded to fit cap *C*. This cap takes the back thrust of lead screw, and in this case I have all back thrust by using the weight, pulley and cord (*I M K*) to hold the carriage back.

The form *F* is attached through the rod *N* to the carriage. The pin *E* is kept in contact with the form by the weight lever *H* seen in Fig. 2. An idea of how the form will some times look can be had by noticing Fig. 3. This form has to be made of such a shape as will turn the cap *C* either ahead or allow it to drop back, so as to take the inaccuracies out of the screw. Of course, before a form can be made it is necessary to locate the errors and also the amount and character of the inaccuracies.

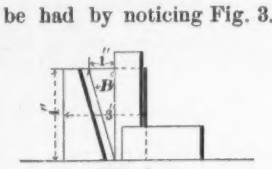

Fig. 4.

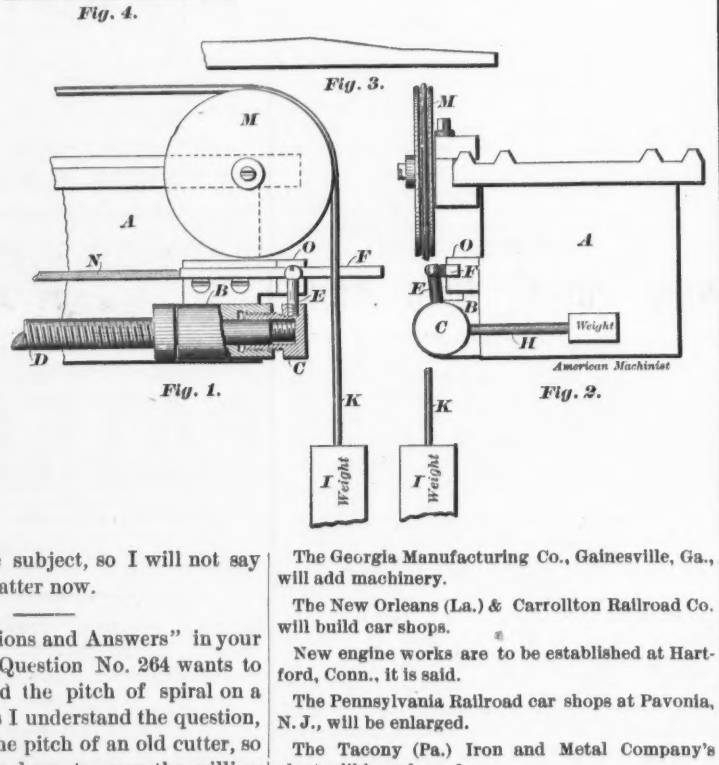

Fig. 3.

Fig. 1. *Fig. 2.*

There are several ways of doing this that I think will be seen by a person who puts thought upon the subject, so I will not say more about the matter now.

In your "Questions and Answers" in your June 30th issue, Question No. 264 wants to know how to find the pitch of spiral on a milling cutter. As I understand the question, he wants to find the pitch of an old cutter, so that he may know how to gear the milling machine in order to follow the old milling. Following this idea, I think it worth while to call attention to the matter. In the first place, it is not a fine point, because the pitch of spirals usually run about the same as threads (in even inches), so we only want to know about what the pitch is, and then we can judge it is the pitch that this estimate came nearest to.

I think as good a way as is needed is to set the cutter on end on a flat surface as in Fig. 4, and set a square so as to determine the amount the spiral teeth are out of square in the length of cutter. This amount is to the circumference of cutter as the length of cutter is to the pitch of spiral. Stated as for the example, $1'' : 9{,}425'' :: 4'' : P$.

Another way of finding the angle of the teeth is to roll the cutter upon a soft piece of board, so that it shall roll parallel with one edge.

A press dispatch from Fargo says: The boycott declared against the Northern Pacific Railroad is being carried out by the merchants and business men of this place. It is claimed by the citizens that the Northern Pacific managers had repeatedly promised to put in a new station and erect a $20,000 hotel. It is asserted that the road has violated every promise and has erected fine stations and hotels at other points. A manifesto has been issued asking merchants to ship their goods over other lines, and a proposition has been made to James J. Hill to furnish a site providing he will erect a suitable hotel building upon it. It is the citizens' intention to keep the warfare up till the Northern Pacific erects a new station, or the several roads running into the city conclude to erect a union depot.

MANUFACTURES

A $6,000 ice factory is being built in Bainbridge, Ga.

McCoy & Bell, Florence, S. C., will put in a new engine.

The Chicago Agricultural Iron Works will erect a new foundry.

Robert Sabodk will establish a machine shop at Hartsell's, Ala.

At Mineola, Tex., a large railroad tool factory will be erected.

The Ontario Iron Works, at Canandaigua, N. Y., will be enlarged.

Phenixville, Pa., is talking of erecting a plant for electric lighting.

R. J. Biggs and others are building an iron foundry at Bardwell, Ky.

The Georgia Manufacturing Co., Gainesville, Ga., will add machinery.

The New Orleans (La.) & Carrollton Railroad Co. will build car shops.

New engine works are to be established at Hartford, Conn., it is said.

The Pennsylvania Railroad car shops at Pavonia, N. J., will be enlarged.

The Tacony (Pa.) Iron and Metal Company's plant will be enlarged.

George White & Son's machine works at London, Ont., is being enlarged.

M. DeBord and J. Haberlate are erecting a foundry at Huntington, W. Va.

The Buffalo (N. Y.) Furnace Co. has been incorporated. Capital, $200 000.

A capital of $9,000 has been raised in Dexter, Me., for the new machine shop.

A large plant for the manufacture of electric cars is talked of at Milford, Mass.

A new machine shop will be built by W. D. Troutner & Co. at Pittsfield, Ill.

The Tampa (Fla.) Street Railway and Power Company will erect a new plant.

Blanks & Gentry will build a foundry and machine shops at South Boston, Va.

A water-works and electric light plant will probably be established at Kent, Wash.

The Perfection Scale Co., of Cortland, N. Y., has organized, with a capital of $20,000

The Kidder Machine Co., of Franklin, Mass., has increased its capital stock to $35,000.

The Poca Iron Company, of Duluth, Minn., has been organized, with capital $50,000.

The recently burned Adams Iron Works at Dubuque, Ia., will be rebuilt at once.

The United States Cutlery Co. has been organized in Trenton, N. J. Capital, $1,000,000.

The Anderson & Irondale (Ind.) Rolling-mill will be enlarged by the new management.

The Western Brass Company, Chicago, Ill., has been incorporated; capital stock, $50,000.

The Chesapeake & Ohio Railroad Company will rebuild its recently burned plant at Richmond, Va.

The Dexter Tool Company, recently organized at Dexter, Me., with a capital of $10,000, are fitting up works.

The Adams Radiator and Boiler Company, of Reading, Pa., capital, $30,000, has been incorporated.

The Roche Spinning Corporation, of New Bedford, Mass., is building a new brick mill, to have 30,000 spindles.

J. R. Palmer and Mr. Cates, of Eagle Lake, will erect an iron foundry and machine shop at Bartow, Ga.

The Indianapolis Frog and Switch Co. has leased a building in Springfield, O., and will remove to that city.

The Guernsey Rolling-mill Company, of Cambridge, Ohio, with a capital of $100,000, has been chartered.

The Muskegon Iron and Steel Company, of Muskegon, Mich., have increased their working capital to $200,000.

It is stated that E. M. Tilley and associates are contemplating the erection of a steel plant at Berkley, Va.

The Ferris Wheel Company, of Chicago, Ill., capital, $600,000, has been organized, to manufacture bicycle wheels.

The Avery Steel Mfg. Company will shortly erect a plant for the manufacture of their specialties in or near Chicago.

W. B. Pollock & Co., of Youngstown, O., have commenced the erection of an 80-foot addition to their boiler works.

At Westboro, Mass., the Beacon Cycle Manufacturing Co. will soon commence to build 1,500 improved chain bicycles.

A $25,000 electric plant will be erected at Boone, Ia., by the recent purchasers of the Boone Electric Company's establishment.

The Rodney Hunt Co. is erecting an addition to its machine shop in Orange, Mass. The addition will be 75x40 feet, two stories.

Articles of incorporation have been filed by the Hogdon & Holt Manufacturing Company, of Laconia, N. H.; capital, $200,000.

It is possible that the Wentworth Spring and Axle Company, of Gardiner, Me., may establish a branch plant at Amesbury, Mass.

Four industries, a steel works, a signal appliances and electrical railroad appliances, will locate in the new town of Garwood, N. J.

The Rogers Typographic Co. has been organized in Detroit, where it will erect a factory for the manufacture of type setting machines.

The American Linen Company, of Fall River, Mass., will have new engines, and will increase the capacity of No. 2 mill 100,000 spindles.

It is reported that James McCoy, of Harriman, Tenn., is endeavoring to organize a stock company to build a rolling-mill at Chattanooga, Tenn.

Wooley & Kenyon, of Anderson, Ind., propose to erect a large brass foundry beside their iron foundry, which will employ a large number of men.

The American Electric Rock Drill Company, Jersey City, Me., has been incorporated, with a capital of $250,000, for manufacturing rock drills.

The Covington (Ky.) Machine Works has increased its capital stock from $35,000 to $50,000, the money to be used as additional working capital.

The Eymon-Evans Manufacturing Co. has been organized in Philadelphia, Pa., with capital $60 000, for manufacturing steam jet apparatus machinery.

The capacity of the locomotive repair shops of the Chicago, St. Paul, Minneapolis, Omaha road, at St. Paul, Minn., is to be largely increased this year.

A branch of the machine works of Mather, Platt & Co., of Manchester, England, is to be established either at Providence or Pawtucket, R. I., it is reported.

Messrs. Roberts, Pancoast, Burt and MacDonald are considering the organization of a stock company to erect bolt and horseshoe works at Harriman, Tenn.

A new $300,000 smeltery will be erected at Pierre, S. D., by a newly organized stock company, the American Smelter and Refining Company, of Kansas City, Mo.

The Bridgeport (Ala.) Land and Improvement Co. has obtained control of the Bridgeport Steel Works, and they will doubtless soon put the plant in operation.

The Baltimore (Md.) Iron and Steel Casting Company has recently erected a well-equipped foundry, embracing a 100′x50′ cast house and a 100′x40′ annealing house.

The Vanderbilt Steel and Iron Company, Birmingham, Ala., will erect an ore-washing plant of 100 tons daily capacity, and are now in the market for equipment.

The Lewis Machine Company has purchased the machinery and patterns of the Rollstone Machinery Company at Bessemer, and will remove same to Oxanna, Ala.

The National Manufacturing Company, Knoxville, Tenn., has purchased the patents of a three-cylinder engine, and will establish works for the manufacture of same.

Negotiations are going on between the owners of a newly invented safety bicycle and citizens of Hartford, Conn., with a view to establishing a plant for their manufacture.

Geo. W. Long, Geo. S. Grier, James C Tawes and others have organized the Crisfield (Md.) Ice Manufacturing Company, to erect an ice factory. The capital stock is $40,000.

The Grant Anti-friction Ball Company has been organized at Portland, Me., for the purpose of manufacturing anti-friction balls and machinery. Capital stock, $100,000.

It is reported that the Lost Louisiana Co. (Bear, Ark.,) has contracted for the erection of a reduction plant for reducing ore by chlorination, its capacity to be 100 stamps.

The Wheeling & Citizens' Railway Co., Wheeling, W Va., contemplates adding new equipment, etc., at a cost of about $250 000. A. M. Jolly, general manager, can be addressed.

The Berlin Machine Works, of Beloit, Wis., are building a three-story addition to their establishment. Its size is 200x66 feet, and it will be of brick, with mill construction.

The Hamburger Cotton-mills has been chartered by Louis, Louis, Jr., and Geo. S. Hamburger, to erect and operate a cotton factory at Columbus, Ga. The capital stock is $30 000.

The Decker & Goebel Machine Co. has been organized at Portland, Me., for the purpose of manufacturing machinery, and especially paper and pulp machinery, with $10,000 the capital.

W. H. Saams, superintendent of the Irwin Electric Light Company, in conjunction with other Irwin parties is arranging to put in a $25,000 electric light plant at West Newton, Pa.

There is water-works agitation in Holyoke, Mass.; Melrose, Mass.; Cumberland, Md.; Englewood, N. J.; Griffin, Ga.; Centralia, Ill.; Farmer City, Ill; Waterbury, Conn.; Elwood City, Pa.

The new tin-plate company which intends building at Tunnelton, W. Va., is manufacturing its own brick for the construction of the works. They expect to have the works in operation by October 1.

The new plant of the Centralia (Ill.) Iron and Steel Company is starting up with 70 or 80 men. Chas. L. McDonald will be the manager of the new concern. The company has been capitalized at $50,000.

Wm. F. McCauley, Edw. H. Griffith, Jos. Schreiber, Gerhard Burke and Chas. G. Hill have incorporated the Bay View Electric Light and Power Co., at Bay View, Md., with a capital stock of $50,000.

A new Indiana corporation is the Cambridge City Punch, Shear and Roll Company, with a capital stock of $50,000; directors, Elwood T. Horner, John A. Spence, Martin L. Young, and Benjamin F. Drischel.

The Irondale Rolling-mill, at Anderson, Ind., has been purchased by George Laughlin, of Cleveland, O., and H. W. Chawle and R. W. Numet, of Chicago, for $35,000 cash. The capacity of the plant will be increased.

Geo. W. Walker, E. E. Dixon and Wm. D. Whelchel have incorporated the Gainesville (Ga.) Light and Power Company, to manufacture and sell gas, electric lights, etc. The capital stock is $5,000 to $50,000.

C. M. Coen will organize a company for the purpose of erecting an electric light plant, ice factory water-works and cold-storage plant at Hyattsville, Md. Address him at his office, Sun Building Washington, D. C.

The citizens of Chambersburg, Pa., are endeavoring to raise $25 000 necessary to retain the Taylor Engine Works from removing to Chicago, parties from the latter city having negotiated for its purchase and removal.

The Knowlton Car Coupling Co., of Superior, Wis., has been formed, for the manufacture and sale of car couplings. Capital stock, $25,000. E. H. B. Knowlton, P. McGuire and P. W. Quigley are the interested persons.

The town commissioners of Elkton, Md., have contracted with the Elkton Electric Light Company, to furnish the town with seventy-five twenty-five candle-power incandescent lamps at $18 each per annum from May 1, 1893.

Work has been commenced on a plant at Ernst station, near Norristown, Pa., for the manufacture of tin-plate. The superintendent of the Cumberland (Md.) Steel and Tin-plate Company states that the plant will be in operation soon.

M. Haralson, A. S. Talley, W. J. Zachry, E. A. Doane and C. W. Smith have chartered the Atlanta (Ga.) Construction Company, to deal in real estate, build and equip electric and other railroads, etc. The capital stock is $30,000, with privilege of increasing to $200,000.

The American Railway Water Supply Co., Memphis, Tenn., which has the control of the patents for the automatic filling of railroad water tanks, is negotiating with the Raleigh Electric Line to put up shops at their terminus. If the trade is made the company will put up a $100,000 plant.

In a recent issue we stated that the Mason & Foard Co., of Eddyville, Ky., was interested in a new foundry being built at Princeton, Ky. Mr. Z. J. Montgomery, general manager of the company, writes us that this is a mistake, and that the M. & F. Company has no interest in the new foundry.

The Eureka Iron and Steel Works, at Wyandotte, Mich., are contemplating the erection of a steel plant, with a daily capacity of 100 tons. This company now manufactures boiler plate and tank iron and bars, its annual capacity being 9,000 net tons of plates, and 24,000 tons of bars. It also has a charcoal blast furnace of 25,000 tons annual capacity.

The Vulcan Iron Works, Wilkesbarre, Pa., are building a large addition to their works—a boiler shop 80x150 feet—to meet their fast growing trade. The blacksmith shop will be increased 50x100 feet thereby, and the foundry will be extended 50 feet, as business has increased to such an extent they are cramped for room and cannot begin to fill their orders.

The B. & J. Coupler Co., of Des Moines, Iowa, has been incorporated, with capital stock of $500,000, for the manufacture and sale of car couplers, patent rights, etc. The following are the promoters of the enterprise: J. W. McClure, W. W. Orris, W. H. Given, James McCaughan, W. S. Jennings, Asher A. Brower, and Geo. W. Ogilvie, all of Des Moines, Iowa.

Gabriel C. McDonald, of the St. Louis Steam Forge and Iron Works, is putting in operation the new plant, at Centralia, Ill., starting with 70 or 80 men. Charles L. McDonald will be the manager of the new concern, which will be known as the Centralia Iron and Steel Company. The company has been capitalized at $50,000. Iron, steel, railroad supplies, nails, etc., will be manufactured.

The Hinsen Car Coupler Company, of Chicago, Ill., contemplates removing its plant to Chattanooga, Tenn. A portion of its product is manufactured in Chicago, and a portion by the Southern Malleable Iron Company, at Chattanooga, and it is proposed to remove the entire works to the Southern company's plant. About 300 additional workmen will be required if the removal is accomplished.

The Indianapolis Switch and Frog Co., of Indianapolis Ind., and Springfield, O., has been given a certificate of incorporation. The capitalization is $300,000. The company will manufacture and sell railway switches, frogs, crossings, tie-bars, and other railway appliances, also bridges and other structural iron work. The following are the interested persons: Fred Gray, Wm. H Parmlee, Harry V. Horton, Elias Jacoby, Albert G. Elvin, Harry Hinesly, and Frank R. Stratford.

The Clonbrock Steam Boiler Works, Thomas J. Lawler, manager, builders of the well-known Morrin "Climax" and Morrin "Compound" boilers have purchased additional ground at the rear of their present shops at Smith street and Hamilton avenue, Brooklyn, N. Y., and are erecting a new 50x200-foot boiler shop as a T extension to the present one. These works have on the floor over 5,000 horsepower and orders to the same extent. The erection of the new building is under the supervision of William H. Weightman, engineer and mill architect, of 29 Broadway, N. Y. City. The New York offices of the Clonbrock Steam Boiler Works are at the Columbia Building, 29 Broadway.

Steam engine builders seem to have difficulty in filling their orders this summer, and travelers on the Central R. R. of New Jersey by night find it very evident that the Ball & Wood Company, of No. 15 Cortlandt street, New York, are among this number, judging from the brilliant appearance of their shops at Elizabethport. Among the last contracts closed by this company is one at Hartford, Conn., for one of their 300 H P. cross-compound improved engines, and another for an engine of similar type for the Edison Electric Illuminating Company, of Paterson, and still another 300 H. P. engine for Waterbury, Conn. Something over 6,000 H. P. in engines are at present in process of construction on their factory floor.

The Wyandance Lace Co. is a new manufacturing concern which is locating at Wyandance, L I. A large brick factory is now being erected, which will give employment to several hundred persons. The secretary is E. D. Langley, 65 Broadway, New York. The president is J. F. Forth of Nottingham, Eng., and the treasurer is J. P. Chapman, of the firm of Hilton, Hughes & Denning, New York City. One of the officers says: "The Wyandance Company will be in full working order three months from now. The reason we shall be ready so soon is that we shall have a complete plant brought over from Nottingham, Eng. We should have had to have the machines made in England anyhow, as they are not yet manufactured in this country. In a few years, no doubt, the machinery will be made here. The seven machines that are coming have been used at the mills in Nottingham, but they are as good as new. Each of the machines weighs five tons, and is in 30,000 pieces, so a person can imagine how complicated it is, and how necessary after awhile it will be to have factories here where these machines are made. It would be expensive to have to send to Nottingham every time a piece of the big machine broke. The delay would be expensive, too."

Machinists' Supplies and Iron.

NEW YORK, August 13, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $15 to $15.50; No. 2, $14 to $14 50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $14.25 to $15 for No. 1 Foundry; $13.50 to $14 for No. 2; and $12.75 to $13.50 for Gray Forge.

Scoton Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is lower.

We quote Hallett's 10¾c. to 10⅞c.; Cookson's, 13c. to 13½c; and L. X., 11⅞c. to 12½c.

Copper—The market is irregular. Business has been done in Lake Copper within the range of 11 60c. to 11¾c. The nominal quotations are 11.50c. to 11.60c. There are bids at 11.40c., without resulting in business. Casting Copper is held at 10¾c. to 11¼c.

Lead The market is weak. Sales have been made at 4c., 4.05c. to 4.10c., the last named for carloads. The market is quoted at 4 05c.

Lard Oil -The market is quoted at 62½c. to 63c. for Prime City. Western on spot is quoted at 61c.

Spelter—The market is dull. Car-load lots are reported sold at 4.75c

Tin—The market is unsettled. Sales of 50 tons August delivery at 20.50c., and 25 tons at 20 45c. have been made. The best bid is 2 40c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Position as foreman molder; reference furnished. Address M., Hopedale, Mass.

Wanted—Agents in every shop for machinists' fine tools, sliding calipers, etc. E.G.Smith, Columbia, Pa.

Ass't mech. dftsman, exp'd in marine, stationary eng. work, desires situation. Box 46, AM MACH.

Designing draftsman wants to make a change; wages, $25 per week. Box 55, AMER. MACHINIST.

Wanted—Position as foreman pattern maker; best New England refs. Box 56, AMER. MACHINIST

Wanted—Position by a mech. eng. as supt., asst. supt., designer or draftsman. T, AM. MACHINIST.

Wanted—Position as draftsman, by an apprenticed mechanic with tech. education and 2 years' exp. in dratting room; age, 23. Box 45, AM. MACH.

Wanted—Six fitters and lathe men wanted at once; only sober and industrious need apply. Charter Gas Engine Co., Sterling, Ills.

Mfrs. Agent—Young, enterprising and aggressive mech. eng. would represent Western firm in N. Y. or travel for mach. builders. Propagator, AM. MACH.

Wanted — Competent foreman for foundry in North Carolina. Both brass and iron. Address Mecklenburg, AMERICAN MACHINIST.

Machinist having patent machine tool patterns, etc., wishes situation in shop that will build same on royalty. Address "Tool," AM. MACHINIST.

Wanted—Position as traveling salesman, by single man, practical machinist, two years on road. Good references. Box 52, AMERICAN MACHINIST.

Wanted—Pos. by practical eng. and electrician, who understands the erecting and taking charge of steam and electric plants. N. N., AM. MACH.

Wanted—Position by a skilled steam engineer and mechanic; can erect new or manage present plant for highest efficiency. Indicator, AM. MACHINIST.

Young man with tech. education and one year's exp. in drafting room desires a situation. Address Box 53, AMERICAN MACHINIST.

Draftsman and designer of machine tools, general and special machinery, and tools for mfrs., desires a change. Box 38, AMERICAN MACHINIST.

Wanted—Position as foreman pattern maker; 25 yrs. exp. and 16 yrs. foreman; best econ'c methods; eng. & mach. work; best refs. Box 51, AM. MACH.

Wanted—A position as instructor in a manual training, trade or tech college; wood-work, pattern making and molding a specialty; best refs. for practical and theoretical ability. Box 50, AM. MACH.

Wanted—Foreman to take charge of machine shop in Canada, manufacturing stationary and marine engines; none but first-class exp'd man need apply to Box 49, AMERICAN MACHINIST.

Wanted—Position as supt; will take entire works on contract if desired. Manufacturers wishing to reduce cost of production will find it to their advantage to correspond. Box 47, AMER. MACHINIST.

Wanted—An exp'd man capable of filling position as superintendent in factory employing 125 hands, manufacturing electric railway supplies; must be thoroughly posted on gear-cutting and must be a hustler Address Box 40, AMER. MACHINIST.

Situation wanted by a competent man as supt. of mfg. shop; would prefer shop building machine tools or high-grade engines. I would agree with a reliable firm to base my compensation on comparative result of first year's work, all conditions considered. Box 54, AMERICAN MACHINIST.

Wanted—Superintendent for one of the largest, most progressive and best known machine tool concerns in the United States; will have entire charge of works; none need apply except those now in similar position with one of the standard tool builders of the country; must be progressive, and in touch with the most modern shop practice. For the right man this is the opportunity of his life; much more back of it than can appear in an advertisement; all communications strictly confidential. Box 31, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d-hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Presses, Wire Form'g Mchy. Am. Tool Wks, Clev, O.

Bolt Cutter Heads a Spec'y. Am. Tool Wks., Clev., O.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Special machinery designed and built. C. F. Langston & Co., 70 N. 4th St., Philadelphia.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

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Meet all requirements more fully and satisfactorily than any other of its competitors.

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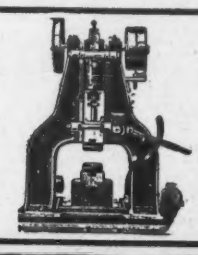

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WHEN ORDERING NEW TOOLS INSIST UPON HAVING VANDERBEEK'S COUNTERSHAFT. SOME OF THE LARGEST SHOPS ARE TAKING THE OLD COUNTERSHAFTS OUT AND PUTTING OURS IN THEIR PLACES. THE STATES MACHINE CO., HARTFORD, CONN.

A TEXT-BOOK OF EXPERIMENTAL ENGINEERING. By Prof. ROLLA C. CARPENTER, M. S., C. E., M. M. E. 8vo. Cloth, $6.00. JOHN WILEY & SONS, NEW YORK.

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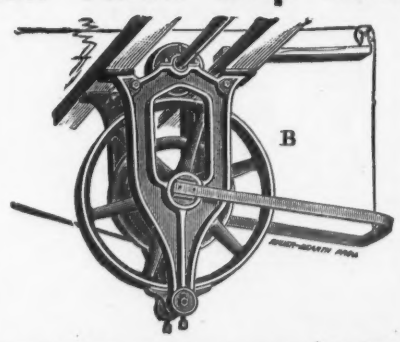

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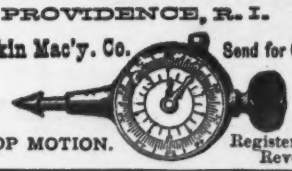

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Machinery and Machinery Castings OF ALL KINDS. PATTERN MAKING And Job Work Desired.

RUFUS K. TOWNSEND, Prop. ALBANY, N. Y. Send for Gear Catalogue.

We are Open to Contract FOR SPECIAL MACHINERY. GEARING A SPECIALTY.

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FOR 20 YEARS these Hammers have been in the market and during all that time have been acknowledged the very best. The material we use and our method of construction are the result of ripe experience and not the jumped-at conclusions of amateurs. Send for circulars and price lists.

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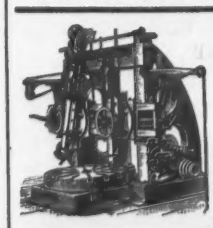

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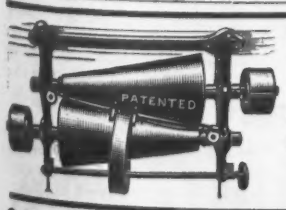
BETTS MACHINE COMPANY, WILMINGTON, DEL.



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ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc. ASBESTOS BOILER COVERINGS. H. W. JOHNS MANUFACTURING COMPANY, H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc. 87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

SOFT GRAY IRON CASTINGS. From ⅛ oz. to 1000 lbs. Small Castings a Specialty. Light machinery wanted to build. ONTARIO IRON WORKS CANANDAIGUA, N. Y.

ENGINE CASTINGS ⅛, ¼, ½, 1 AND 2 HORSE POWER High Speed, Upright, Horizontal, Marine. ILLUSTRATED BOOKLET FREE. A. L. WEED & CO., 106-108 Liberty St., N. Y.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

George D. Slade, dealer in molding sand of all grades, Waterford, N. Y.

Wanted lists of fittings, etc.: specity., design & superv'n, etc., mach'y. C. Mantle, 598 E. 134th St., N.Y.

Wanted—A specialty to manufacture either heavy or light work. We have splendid facilities. Address "Manufacturers," Rockford, Ill.

Agency wanted—A young, energetic mechanical engineer wants to represent some good firms for Buffalo and surroundings. Box 44, care AM. MACH.

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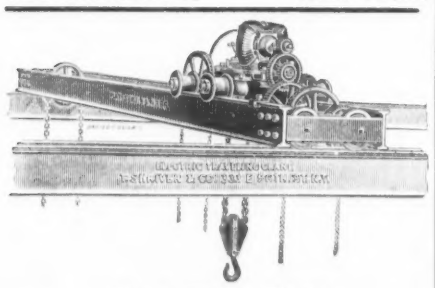

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22 do	12 do	New		Blaisdell
22 do	8 do	do		Flather
22 do	10 do	do		do
20 do	8 do	do		do
20 do	10 do	do		do
18 do	8 do	do		do
18 do	10 do	do		do
18 do	8 do	do		Blaisdell
18 do	16 do	do		do
16 do	8 do	do		Flather
16 do	6 do	do		Blaisdell
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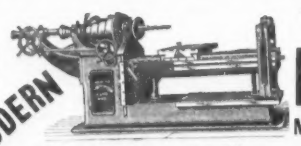

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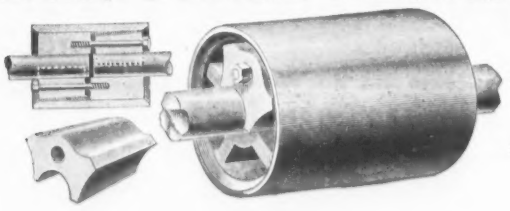

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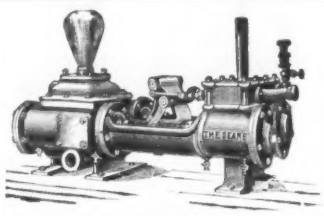

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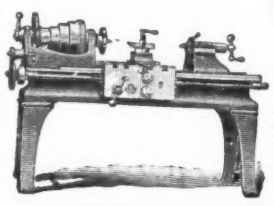

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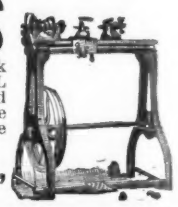

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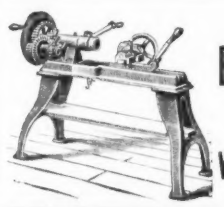

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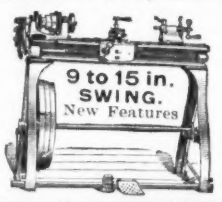

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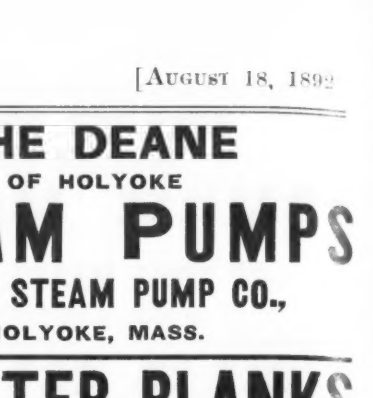

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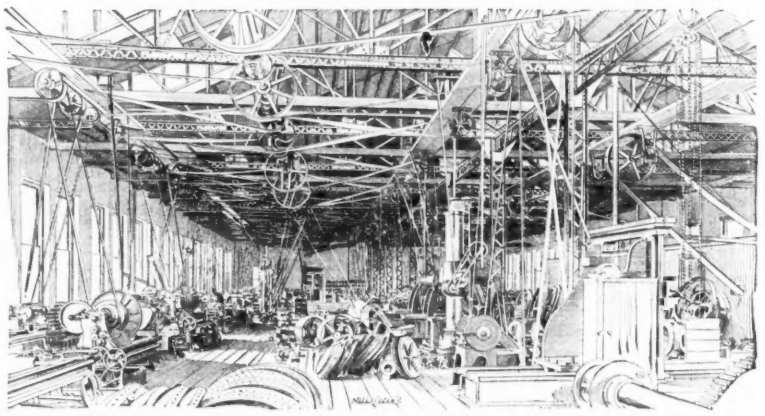

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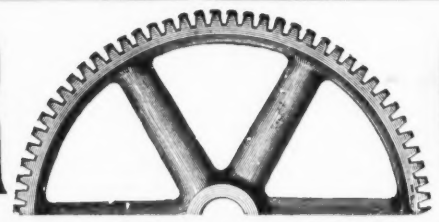

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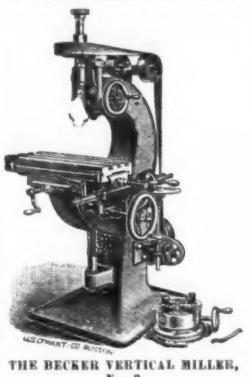

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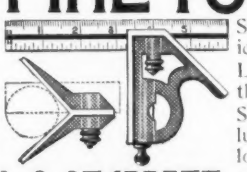

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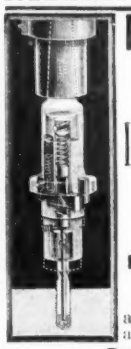

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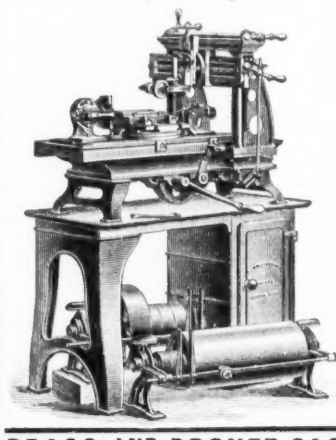

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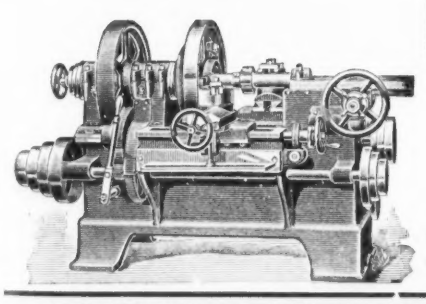

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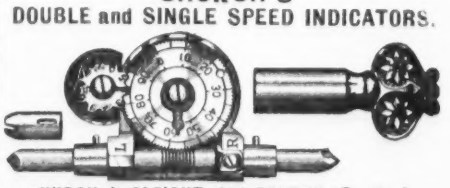

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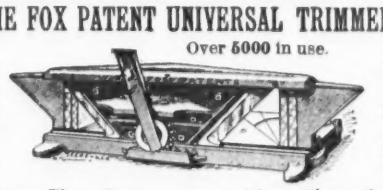

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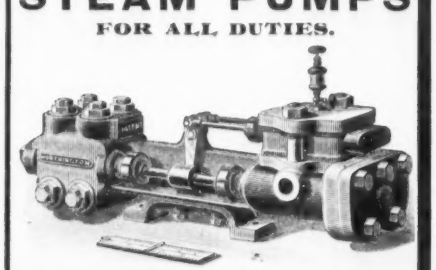

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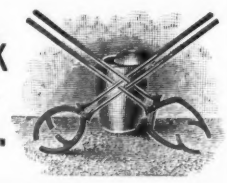

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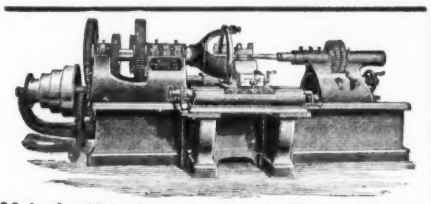

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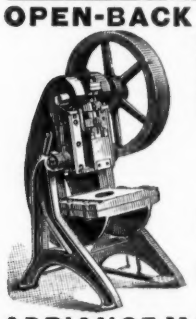

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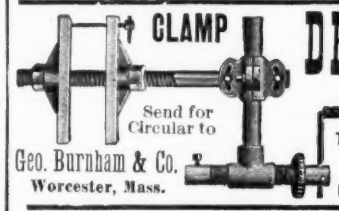

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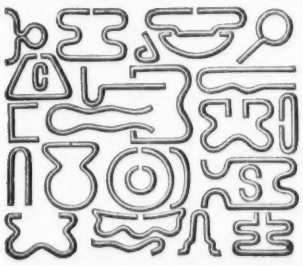

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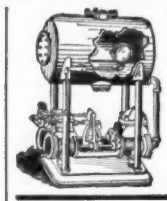

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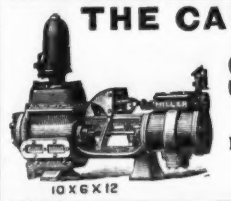

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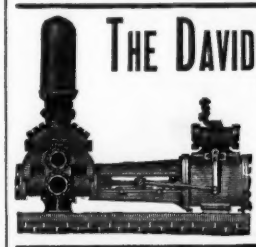

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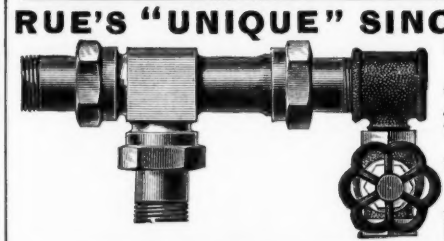

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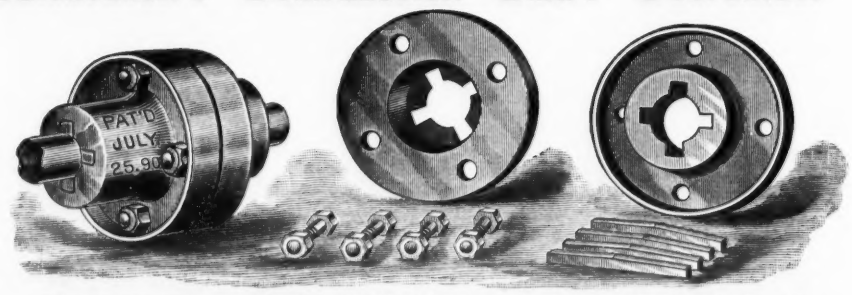

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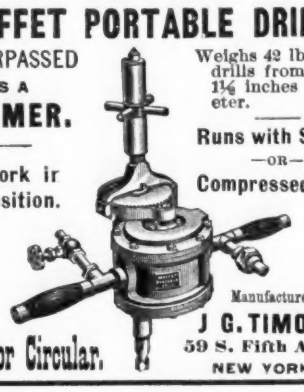
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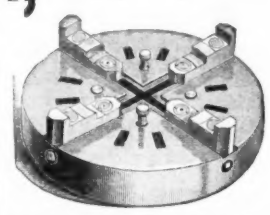

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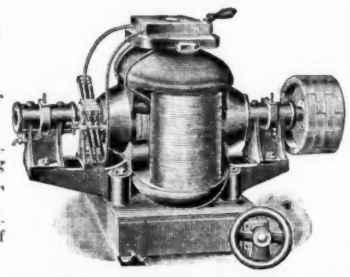

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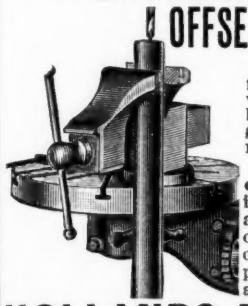
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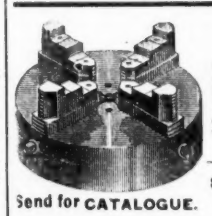
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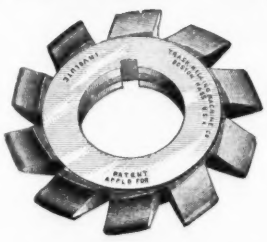
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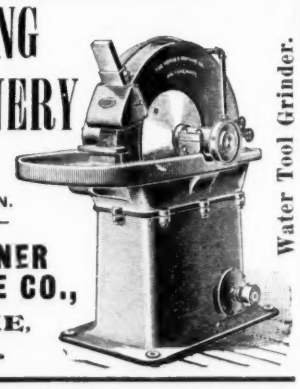
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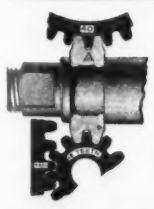
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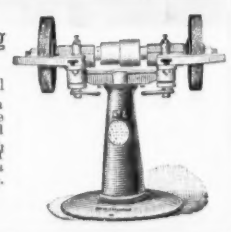

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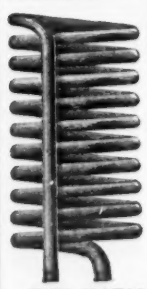
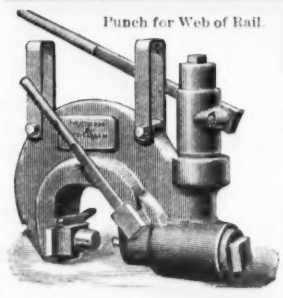
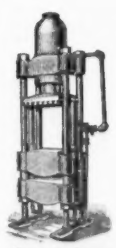

COILS & BENDS
—OF—
IRON,
BRASS and COPPER
PIPE.
ALL STYLES.
THE NATIONAL PIPE BENDING CO.,
82 River Street, NEW HAVEN, CONN.

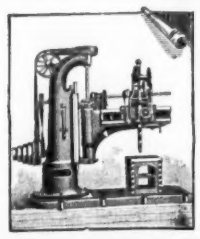
Punch for Web of Rail.

HYDRAULIC MACHINERY,
PRESSES, PUMPS, PUNCHES,
JACKS, VALVES, FITTINGS, PACKINGS,
ACCUMULATORS,
WATSON & STILLMAN, Mfrs.,
204, 206, 208 & 210 E. 43d St., New York.

Forging Press.

PUTNAM MACHINE COMPANY,

Builders of the

NEW PUTNAM AUTOMATIC

Putnam Standard Lathes,
Putnam Gap Engine Lathes,
Putnam Speed & Drilling Lathes,
Futnam Pattern Makers' Lathes,



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CUT-OFF STE M ENGINE,

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Putnam Car Wheel Borers,
Putnam Hydrostatic Presses,
Putnam Railroad Cranes.

ENGINE LATHES.

12in. 20in. & 30in. Swings.

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BENCH DRILL PRESSES

ARE OUTSELLING ALL OTHERS.

SEND FOR NEW DRILL PRESS PAMPHLET.

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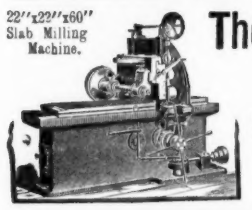
22"x22"x60" Slab Milling Machine.



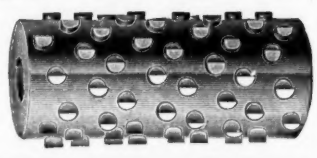
The INGERSOLL MILLING MACHINE CO.,

ROCKFORD, ILLS.

Manufacturers

Ingersoll Patent Cutter,
Ingersoll Slab Milling Machines.

Pat. Dec. 24, 1889.



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Horizontal Drill and Boring Tools.
Column Facing Lathes.
Pit Lathes.
Truck Wheel Grinders.
Boring Bars, &c.
Electric, Steam and Hand Cranes.

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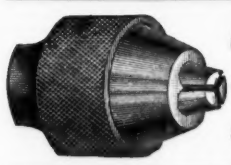
BUILDERS OF

UPRIGHT RADIAL AND UNIVERSAL Radial Drills.

Boring & Turning Mills.

3 PIKE ST., CINCINNATI, O.



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Sold at all Machinists' Supply Stores.

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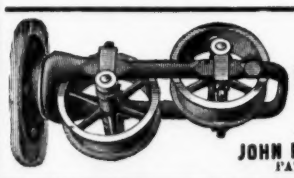

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FOR *Light Belts.*

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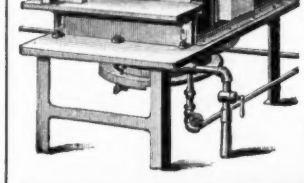

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Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

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HEAVY AND LIGHT **CASTINGS** IRON OR BRASS.

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GENERAL MACHINE WORK. Write for CATALOGUE. CORRESPONDENCE INVITED.

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Manufacturers of STRAIGHT-LIP INCREASE **TWIST DRILLS**

SOLID AND SHELL REAMERS, MILLING CUTTERS, TAPS, SOCKETS, "STANDARD" TWIST DRILL GRINDING MACHINE CHUCKS AND SPECIAL TOOLS.

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Mechanical Engineers and Machinists.

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LANDIS BROS.,

WAYNESBORO, PA.

GENTLEMEN:—We take pleasure in stating that we are very well pleased with the Universal Grinding Machine bought from you some time ago, and consider it a well designed and well made tool.

Yours truly,
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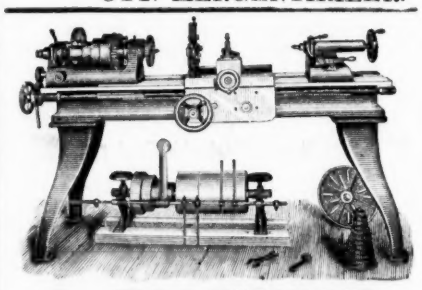

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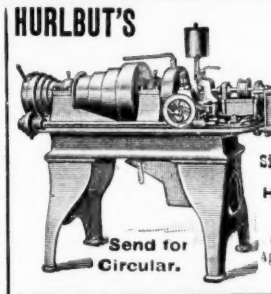
MANUFACTURER OF SUPERIOR 14-INCH LATHES, TOOL GRINDING MACHINERY, TRAVELING CRANES, ETC.

Special Machinery designed and constructed.

HURLBUT'S



Patent Cutting-off and Centering Machine.

Sizes, 2", 3", 4", 5", 6"

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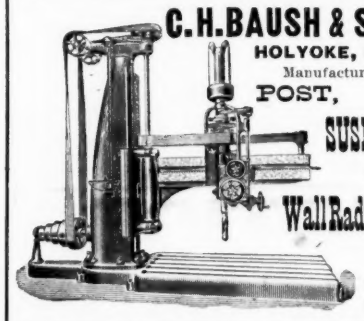

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Makers of Implements for Standard Measurements.

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COMPLETE MACHINE SHOP EQUIPMENTS.

The Latest Improved Tools. Accurate--Rapid--Powerful--Rigid.

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☞ HAND AND SPEED LATHES.
☞ FOX MONITOR LATHES.
☞ UPRIGHT DRILL PRESSES.
☞ PLAIN RADIAL DRILLS.
☞ UNIVERSAL RADIAL DRILLS.
☞ SENSITIVE DRILLS.
☞ IRON PLANERS, 22 to 36 inch.
☞ IRON SHAPERS, 15 to 32 inch.
☞ UNIVERSAL MILLING MACHINES.
☞ PLAIN MILLING MACHINES.
☞ SCREW MACHINES.
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EXAMINE OUR TOOLS BEFORE BUYING.

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Builders of IMPROVED STANDARD MACHINE TOOLS.

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Coventry, England, ALFRED HERBERT. CLEVELAND HOUSE, 32 South Water St.

☞ SEE ADVERTISEMENT ON PAGE 20.

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Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

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HAND LATHES, FOOT LATHES AND MILLING MACHINES.

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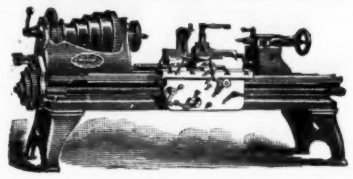

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PATENTED.
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Shaping Machines,
Drilling Machines,
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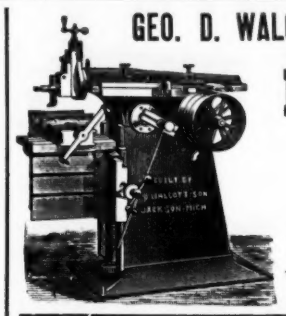
Extra Heavy. Latest Design. All Modern Improvements.

L. W. POND MACHINE CO., WORCESTER, MASS.



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JACKSON, MICH.
Write us for Photo and Prices.

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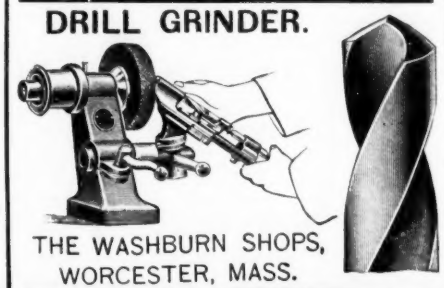

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New Friction Disk Drill

FOR LIGHT WORK.

Has these Great Advantages: The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive with equal safety the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage. Send for catalogue.

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FOR THE BEST PLANER CENTER

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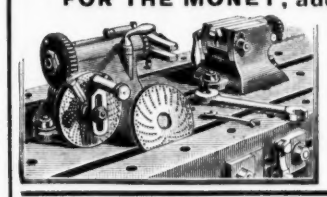

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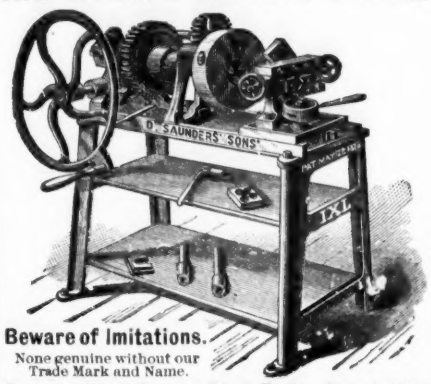
PIPE CUTTING & THREADING MACHINE.



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Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.

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Manufacturers of
Lathes & Upright Drills.
Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world.
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Every Machine Guaranteed.

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Manufactured by
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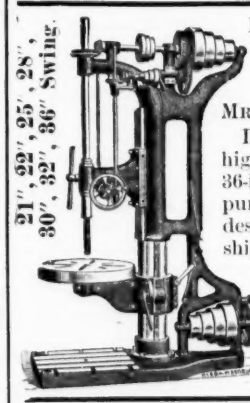

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DEAR SIR:—We are highly pleased with the 36-inch Drill Press we purchased of you. In design and workmanship it has no superior. In operation it is accurate and powerful.

Respectfully,
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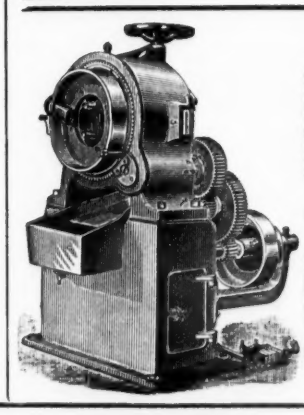

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Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.

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WE ARE OPEN TO CONTRACT

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WE WILL GUARANTEE TO do more accurate BOLT THREADING than any machine made. Changes from one size to another can be made in one minute. No complicated head to get out of order.

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MANY ENGINEERS

imagine if they ask the owner of a plant to buy a Reducing Valve or Pressure Regulator, it makes no difference as to the kind. Let them specify a **"MASON,"** and they will quickly find out the difference.

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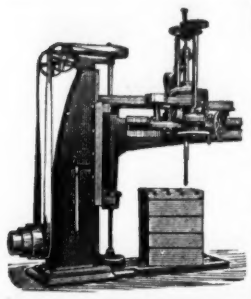

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TRAVELING CRANES AND SWING CRANES,
Operated by Electricity, Shafts or Independent Engines.
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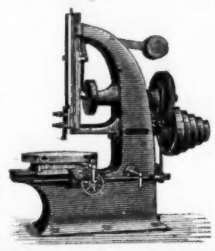
INJECTORS FOR ALL CLASSES OF BOILERS.



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BUILDERS OF
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FOR
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NEW YORK OFFICE, EQUITABLE BUILDING.
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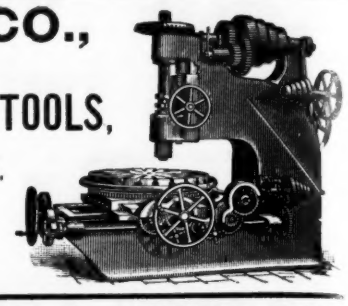

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Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
PUNCHES and SHEARS,
OVER 300 SIZES.
ALSO
POWER CUSHIONED HAMMER.
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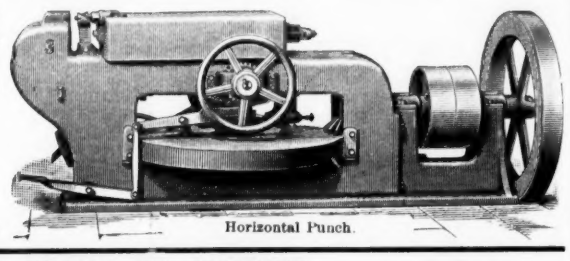
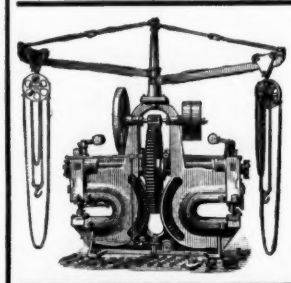


Horizontal Punch.



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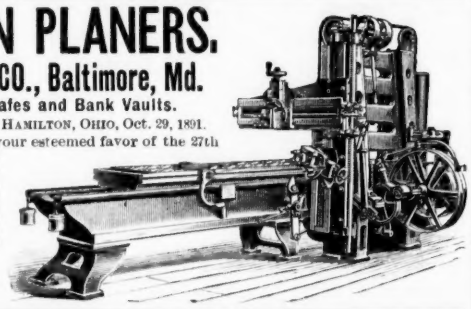
—MANUFACTURERS OF—
MACHINE TOOLS
—FOR—
Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc.
Cut shows our DOUBLE PUNCH AND SHEAR WITH JIB CRANES, for Boiler and Ship Work.

THE OPEN SIDE IRON PLANERS.
THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.
MACNEALE & URBAN SAFE & LOCK CO., Safes and Bank Vaults.
HAMILTON, OHIO, Oct. 29, 1891.
DEAR SIRS: We beg to acknowledge the receipt of your esteemed favor of the 27th inst., and in reply will say that we now have had two of your Open Side Iron Planers in use for about a year. We have found both machines good and efficient tools, and well adapted for the class of work that we do on them—namely—planing the edges of large iron and steel plates varying in size from 2 to 12 feet square. We are well satisfied with the work that the machines do. We cheerfully recommend the planers to those having the same class of work to do that we have.
Yours truly,
MACNEALE & URBAN SAFE & LOCK CO.,
H. URBAN, President.



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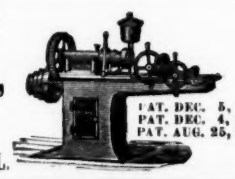

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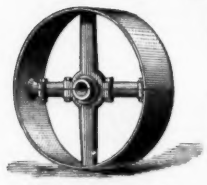

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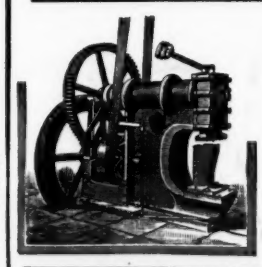

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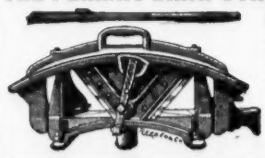

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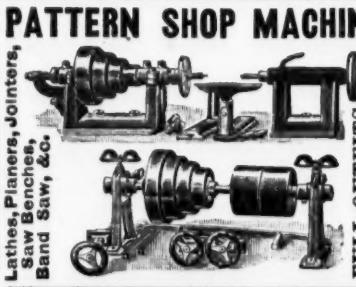

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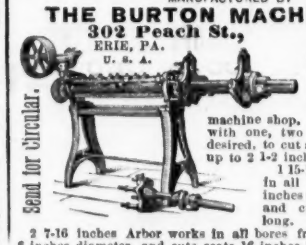

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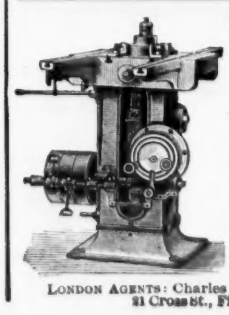

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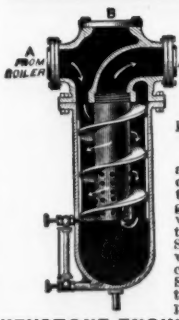

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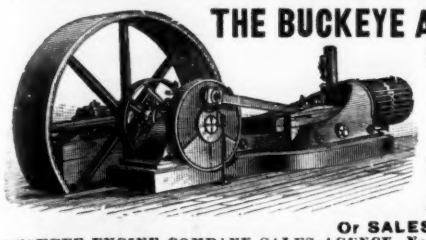

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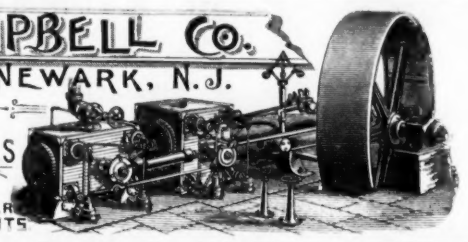

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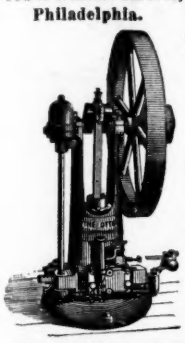

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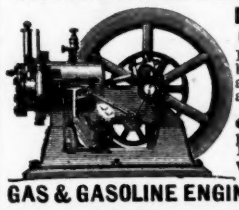

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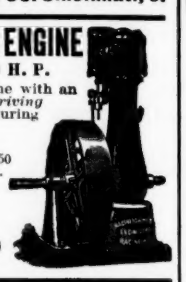

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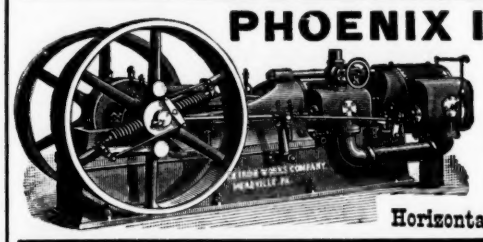

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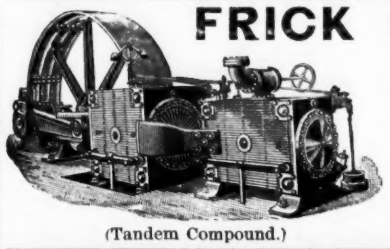

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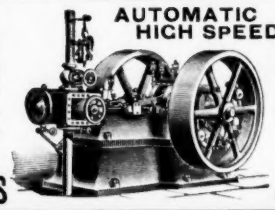

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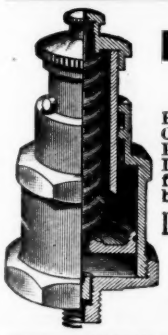

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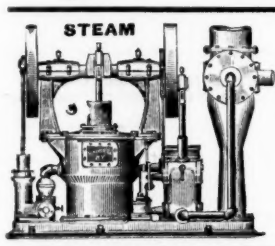

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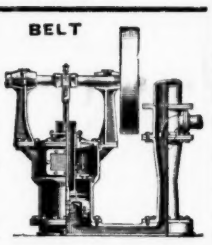

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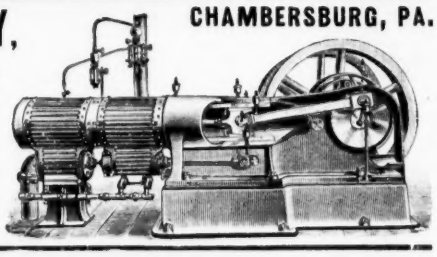

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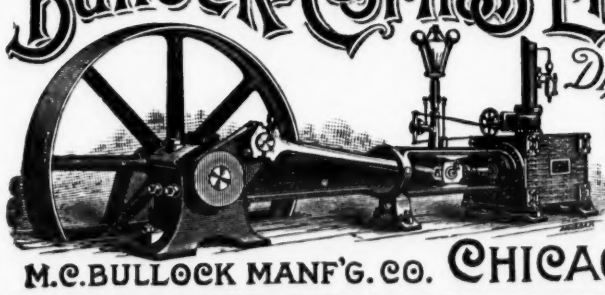

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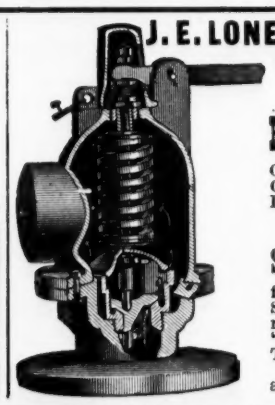

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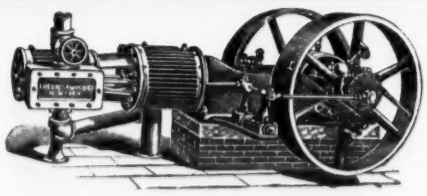

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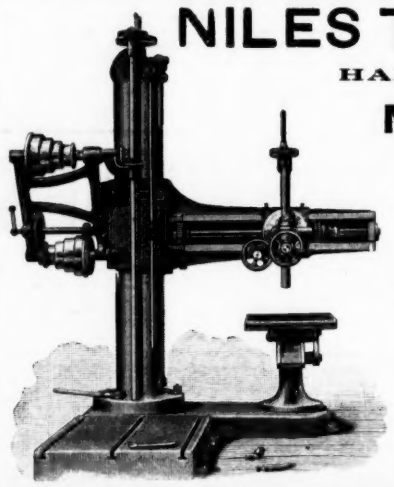

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Four sizes. These are particularly well adapted to general machine shop work.

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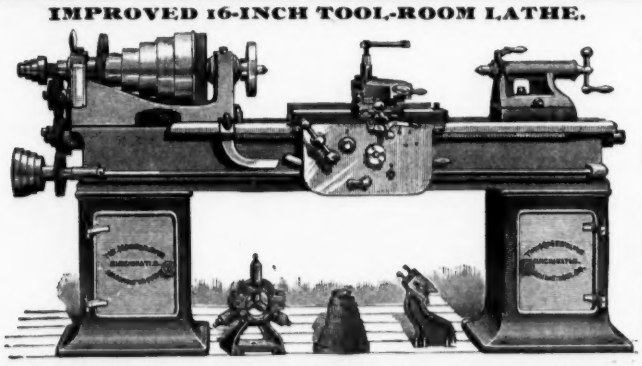

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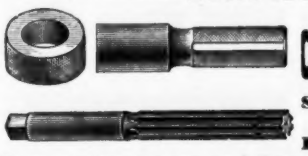

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WE FURNISH CUTTERS FOR U. S. S. THREADS TO FIT THESE TOOLS.

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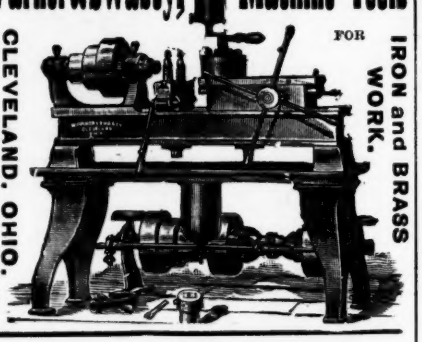

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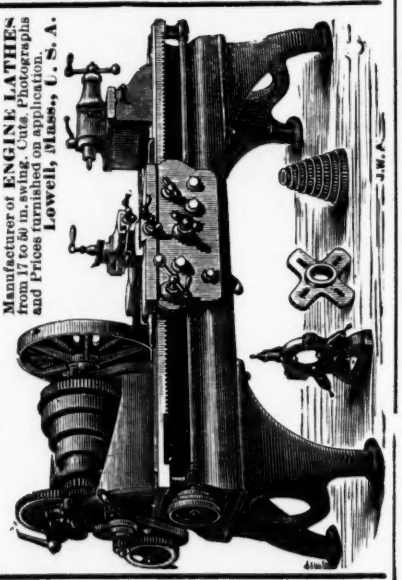

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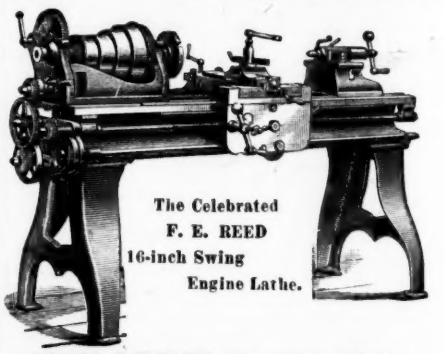

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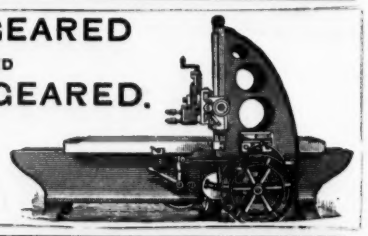
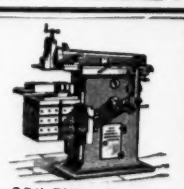


24" Pillar Shaper.

15" Pillar Shaper.



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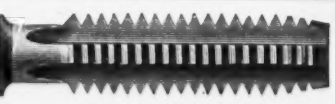

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